Smart Mathematics Tutor

1 Introduction

1.1 Overview

Our project 'Smart Mathematics Tutor' includes shape recognition system. The aim of our project is to create tutoring assistant which will prove to be effective in helping students to practice shape recognition exercises. For the assistant to provide the needed guidance to a student who are learning to recognise the shapes, it is necessary to take into consideration both the shape that is needed to be recognised, as well as the name of the shape proposed by the learner.

This tutoring assistant will use a shape generator designed to test the knowledge of the student. This shape generator is created by our team to form different shape so that the students can try guess the name of the shapes and find if their answer was correct or not which will help them build their knowledge in an easy way. Shape detection is the identification of a shape in the image along with its localisation and classification. It has wide spread applications and is a critical component for AI based software systems. And by using this shape detection our tutor will help students learn about different shapes.

1.2 Purpose

Our website being a computer based online system, it can be proved to be efficient and easy in creating different shapes and recognizing them which will be helpful for students who are learning about shapes.

2 Literature Survey

2.1 Existing problem

Shape detection is the identification of an shape in the image along with its localisation and classification. It has wide spread applications and is a critical component for AI based software systems. This report seeks to perform a rigorous survey of modern shape detection algorithms that use Machine learning. As part of the survey, the topics explored include various algorithms, quality metrics, speed/size trade-offs and training methodologies. This report focuses on the two types of Shape detection algorithms - CNN and Data Pre-processing. Techniques to construct detectors that are portable and fast on low powered devices are also addressed by exploring new lightweight convolutional base architectures. Ultimately, a rigorous review of the strengths and weaknesses of each detector leads us to the present state of the art.

2.2 Proposed solutions

"Shape Matching and Object Recognition Using Shape Contexts", proposed shape detection method using a feature called shape context. Shape context describes all boundary points of a shape with respect to any single boundary point. Shape recognition can be achieved by matching this feature with a prior knowledge of the shape context of the boundary points of the object.

3 Theoretical Analysis

3.1 Block Diagram
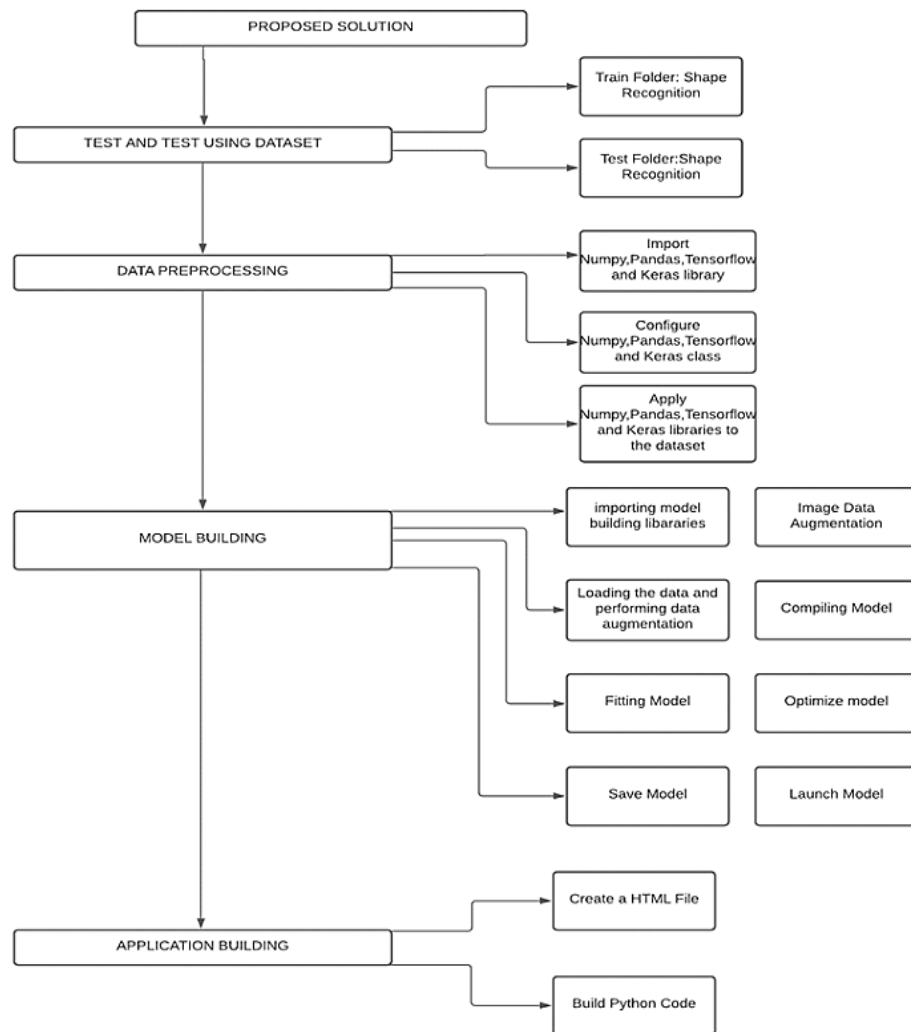
3.2 Hardware/Software designing

Hardware requirement: Laptop

Software requirement: Python – 3.6, Keras, TensorFlow, Spyder, Juypter Notebook

4 Experimental Investigations

We investigate shape recognition that models the decision based on supervised learning, where the model is built up based on previously labelled inputs denoted as templates; the set of already known inputs is denoted as training and testing set.
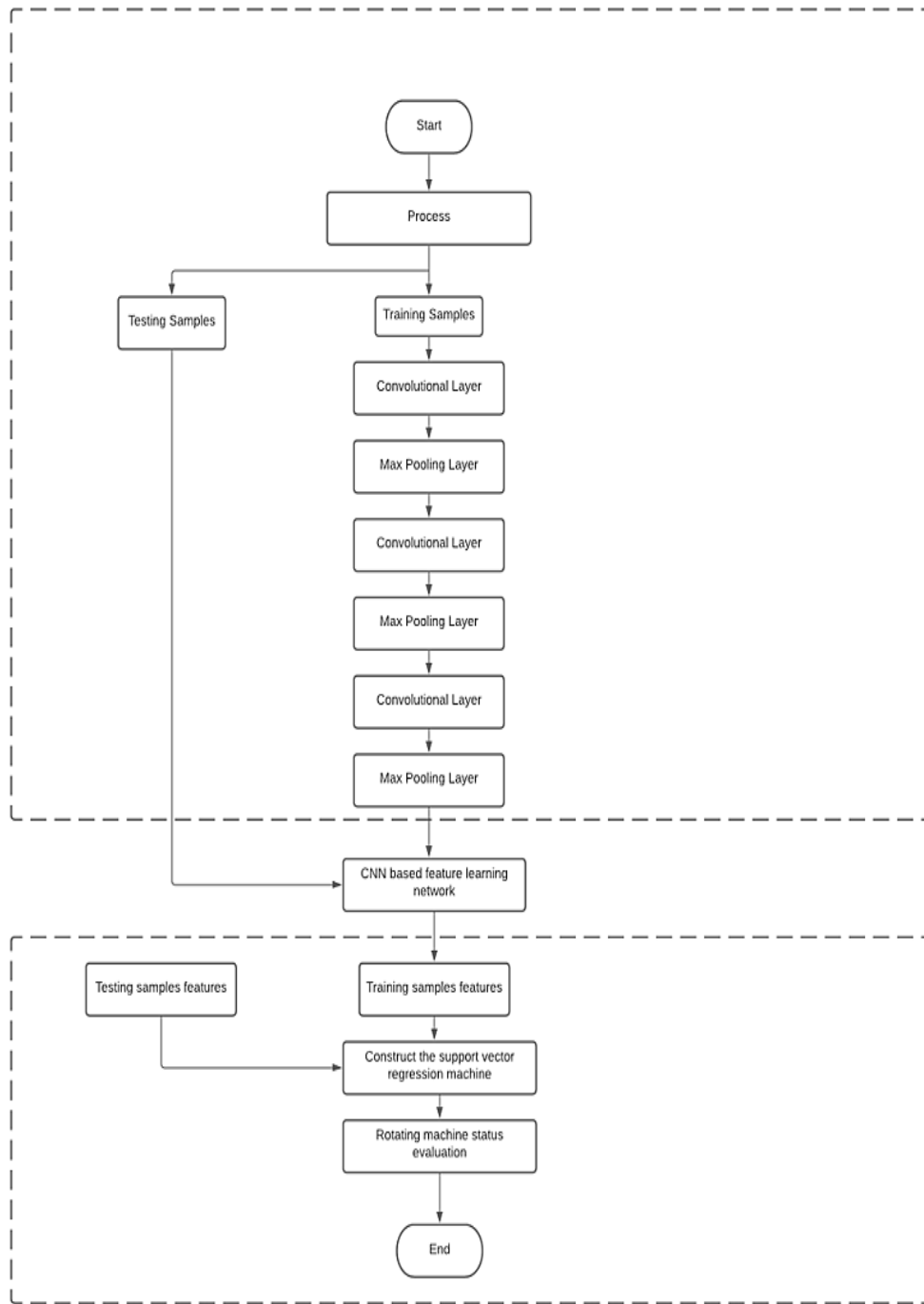
Independently from the exact type and behaviour of the classifier, the classification is a comparison of the input to labelled elements from the training set (or a model built up from the set), where the decision is a function of the representation.

The difference between the representations of the same object is a result of various distortions that occur during the shape acquisition and Data pre-processing.

The task of the recognition is not the reconstruction of the original shape by mathematical operations but to classify independently from transformations that distort the original and the template shapes and thus to estimate the ground truth.

The major challenges of shape detection are to ignore the differences in the representation resulting by sensing and preprocessing and to recognize if the difference is caused by different input objects.

5 Flowchart

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                          ┌─────────┐
                          │  Start  │
                          └─────────┘
                               │
                               ▼
                          ┌─────────┐
                          │ Process │
                          └─────────┘
                               │
          ┌────────────────────┤
          ▼                    ▼
  ┌───────────────┐   ┌─────────────────┐
  │Testing Samples│   │Training Samples │
  └───────────────┘   └─────────────────┘
          │                    │
          │                    ▼
          │           ┌─────────────────┐
          │           │Convolutional Layer│
          │           └─────────────────┘
          │                    │
          │                    ▼
          │           ┌─────────────────┐
          │           │Max Pooling Layer│
          │           └─────────────────┘
          │                    │
          │                    ▼
          │           ┌─────────────────┐
          │           │Convolutional Layer│
          │           └─────────────────┘
          │                    │
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          │           │Max Pooling Layer│
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          │           │Convolutional Layer│
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          │           ┌─────────────────┐
          │           │Max Pooling Layer│
          │           └─────────────────┘
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          │                    ▼
          │           ┌──────────────────────┐
          └──────────▶│ CNN based feature     │
                      │ learning network      │
                      └──────────────────────┘
                               │
   ┌───────────────────────┐   ▼
   │Testing samples features│  ┌───────────────────────┐
   └───────────────────────┘   │Training samples features│
          │                    └───────────────────────┘
          │                             │
          │                             ▼
          │           ┌──────────────────────────┐
          └──────────▶│ Construct the support     │
                      │ vector regression machine │
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                               ▼
                      ┌──────────────────────┐
                      │ Rotating machine     │
                      │ status evaluation    │
                      └──────────────────────┘
                               │
                               ▼
                          ┌─────────┐
                          │   End   │
                          └─────────┘
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6 Result

Smart Mathematics Tutor developed by us is an achievement that could change the education and learning experience of a student. It keeps it easy for the students to learn and for the teachers to perform their duties in a better way.

The Modules of Smart Mathematics Tutor developed by our team shows their own efficiency and effectiveness. With the help of this system, it will be easy to manage and upgrade the tutor system according to the demand and requirements.
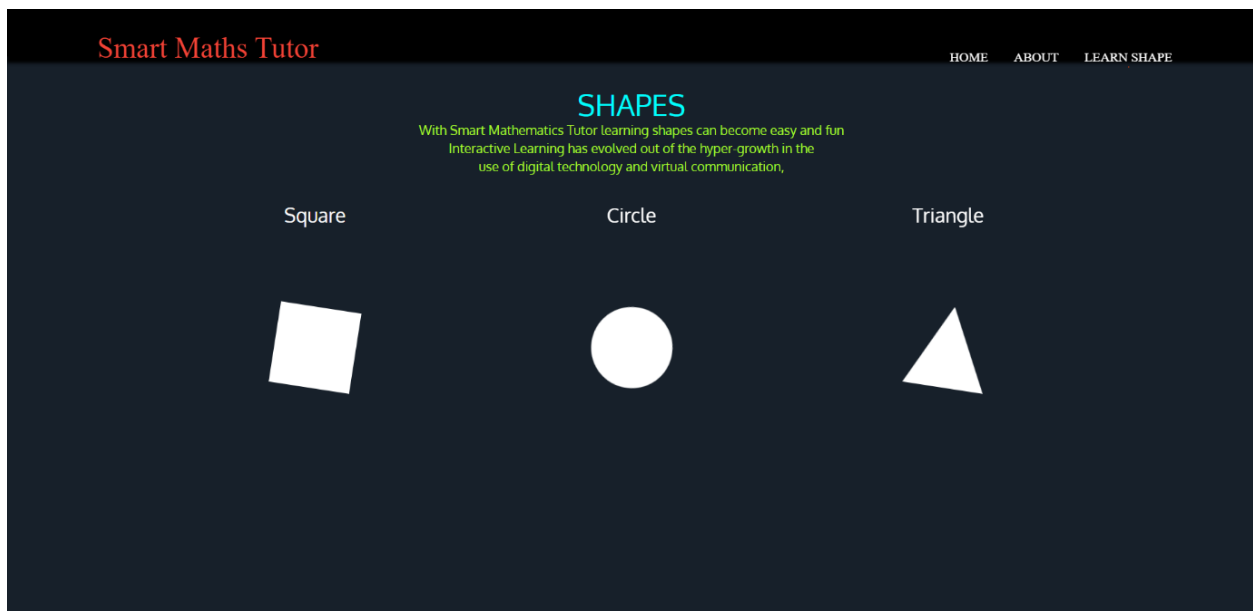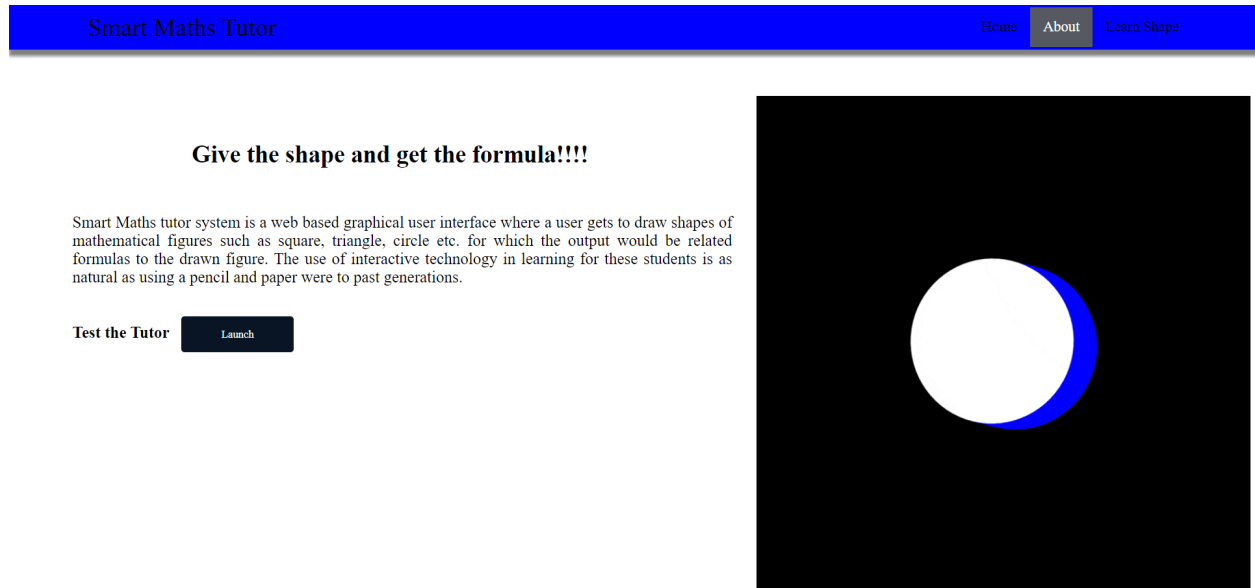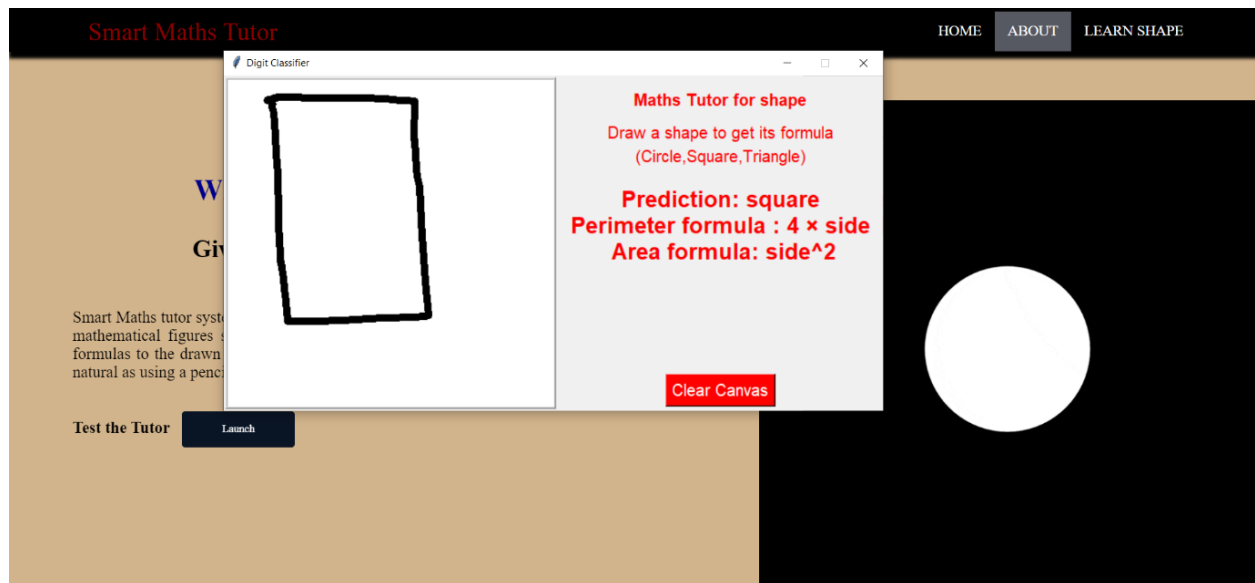

Fig 6.1 Home page

Fig 6.2 About us page

Fig 6.3 Learn shape page

7 Advantages and disadvantages

Advantages of Smart Mathematics tutoring systems are:

1. Be available at any time of the day, even late at night before an exam.

2. Provide real-time data to instructors and developers looking to refine teaching methods.
3. Reduce the dependence on human resources

4. Help students better understand material by allowing them to first explain what they know, then by catering responses accordingly

5. Afford educators the opportunity to create individualized programs due to their personalized nature.
6. Yield higher test scores than traditional systems, especially in students from special education, non-native English, and low-income backgrounds.

7. Provide immediate yes/no feedback, individual task selection, on-demand hints, and support for mastery learning.

Disadvantages ofSmart Mathematics tutoring systems are:

1. It is difficult to assess the effectiveness of SMT programs.

2. Immediate feedback and hint sequences fail to develop deep learning in students.

3. Systems fail to ask questions of students which might explain their actions.

4. The implementation of SMTs may be difficult to justify to an administrative staff.

5. Human tutors are currently better able to provide appropriate dialogue.

8 Application

Shape detection is breaking into a wide scope of enterprises, with use cases extending from individual security to efficiency in the working environment. Shape detection is applied in numerous territories of image processing, including picture retrieval, security, observation, computerized vehicle systems and machine investigation. Critical difficulties remain in the field of object detection. The potential outcomes are inestimable with regards to future use cases for object detection.

Tracking objects

A Shape detection framework is additionally utilized in tracking the shapes/objects, for instance tracking a ball during a match in the football world cup, tracking the swing of a cricket bat, tracking an individual in a video.
Object tracking has an assortment of uses, some of which are surveillance and security, traffic checking, video correspondence, robot vision and activity.

Automated CCTV surveillance

Surveillance is a necessary piece of security and watch. Ongoing advances in computer vision innovation need to prompt the improvement of different programmed surveillance systems. Be that as it may, their viability is influenced by numerous factors and they are not totally dependable. This examination researched the capability of an automated surveillance system to diminish the CCTV administrator outstanding task at hand in both discovery and following exercises.

People Counting

Shape detection can be additionally utilized for People counting. It is utilized for dissecting store execution or group measurements during festivals. These will, in general, be progressively troublesome as individuals move out of the frame rapidly.

9 Conclusion

We presented a new shape description and classification method. Key characteristics of our approach are the compound descriptor and classifier that join the region and contour-based features. We suggested an online learning method to extend the representative set and increase performance. We proposed a representative set optimizing algorithm as well.

The core idea behind our method is the two-level description and classification: for an input shape, low-level, global statistical information is extracted to roughly select the set of similar objects and to reject obviously different templates. In the second stage, local edge information is investigated to find the closest known shape but with the ability to reject the match. The refusal is based on the acceptance radius that is specified individually for every item in the representative set according to the properties of the local proximity in the feature set.

Results demonstrate a high precision rate (99.83%) and an acceptable recall rate (60.53%), which fulfil the requirements for a safety-oriented visual application processing an image flow. The reason to have lower cover is that input frames contain highly deformed shapes, which, for sake of reliability, are classified as nonrelevant inputs. The recall is acceptable, as long as a continuous input is available. Compared to other classifiers, none of the tested ones could outperform the AL-NN in precision, and the same recall could only be reproduced with significantly lower precision. If a final decision is made based on multiple input frames and multiple clues, the false-positive error can be minimized to be practically negligible.

10 Future Scope

This report elucidates shape detection, one of the highly computational applications that has become possible in recent years. Although detecting shapes in a given image or video frame has been around for years, it is becoming more widespread across a range of industries now more than ever before.

Shape detection in images and video has received lots of attention in the computer vision and pattern recognition communities over recent years. We have had great progress in the field, processing a single image used to take 20 seconds per image and today it takes less than 20 milliseconds.

Of the problems related to these fields, analysing an image and recognizing all shapes remains to be one of the most challenging ones

Although the possibilities are endless when it comes to future use cases for shape detection, there are still significant challenges remaining.

Herewith are some of the main useful applications of shape detection: Vehicle's Plates recognition, self-driving cars, tracking shapes, face recognition, medical imaging, shape counting, shape extraction from an image or video, person detection.

The future of shape detection technology is in the process of proving itself, and much like the original Industrial Revolution, it has the potential to free people from menial jobs that can be done more efficiently and effectively by machines. It will also open up new avenues of research and operations that will reap additional benefits in the future.

Thus, these challenges circumvent the need for a lot of training requiring a massive number of datasets to serve more nuanced tasks, with its continued evolution, along with the devices and techniques that make it possible, it could soon become the next big thing in the future.

11 Bibilography

- https://smartinternz.com/Student/guided_project_info/5958#
- https://www.w3schools.com/
- https://stackoverflow.com/
- https://www.geeksforgeeks.org/

Appendix

Source code

1. https://smartinternz.com/Student/guided_project_info/5958#
2. Github