HaateKhori: A Learning Environment for Children

MD Sabbir Rahman
sabbirrahman42@iut-dhaka.edu
ID: 180042142

Ratul Mahjabin
ratulmahjabin@iut-dhaka.edu
ID: 180042123

Mohtasim Hadi Rafi
mohtasimhadi@gmail.com
ID: 180042145

Sabbir Ahmed
sabbirahmed@iut-dhaka.edu
(Supervisor)
Department of Computer Science & Engineering
Islamic University of Technology, Gazipur-1704

Abstract:
This is a project that is intended to help the child and their parents in their education. There are mainly three types of features: learn to write, know your surroundings, and know you. Learn to write by helping in writing Bangla and English characters and numbers. In knowing your surroundings, the child will learn and identify different shapes and objects. Know your feature is to help a child in learning and identifying relatives and body parts.

Introduction
We know about character recognition, object detection, face detection which can be done with the help of machine learning. So our goal is to use that kind of technique in child education. We all know today parents are very busy with their work and house workers are not enough for child education. Often we are very obsessed and tired with child questions. We lost our patience. Another problem is that often we don't know how to teach children. Our different accents, handwriting, and behavior can also become obstacles for child education. Our target is to help a child and their parents in this scenario. Another important thing is that we also track the child's learning rate and profile which can be very helpful. Mainly it will be creating an environment where kids will be able to learn things easily and interactively with the help of technology

Project overview
We already know about the feature. But let's explain this. The solution is classified into the following categories and it will feature them accordingly

Character Recognition:
- Level 0(Writing through dotted lines): A dotted line will be given. User has to draw the character following the dotted line.
  - ❖ Level 1(Writing seeing animation): An animation/tutorial of drawing a character will be given. It will be shown at first then the user will be asked to draw the exact character.
  - ❖ Level 2(Writing seeing a picture): A picture of a character will be given. The user then will be asked to draw the character.

On each level the input will be collected and analysed by the system. Then the accuracy will be shown.

Object Recognition:
- Shape detection
  - Level 0: learn and identify shape from a given image by the system
  - Level 1: count the number of shape in the given image
- Object detection
  - Level 0 : learn and identify object from the given image by the system

Face Recognition
  - Level 0 : learn and identify relatives from the given image by the user input(with label)
  - Level 1 : learn and identify body parts from the given image by the system and the user(child)
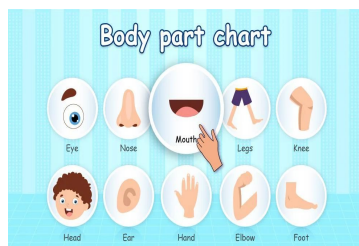
Project Analysis
This is a very exclusive project. We search a lot and find some apps about child learning but they are very simple and native. There is no help from machine learning. Doing this learning of the child is not intuitive. Those software hardly evaluate how much children learn. They can not

identify about child learning. Child may learn object from these but this is not dynamic. We don't find anything that help child to learn their relatives and child own body parts. Let's talk about some app.

For example this app named Kindergarten Kids Learning App : Educational Games[1] with a total number of one million downloads is one of the most famous apps in the play store.

In the app, they focused on learning alphabets with different activities and games but they didn't focus on writing and evaluation. For example, in the part where they taught about body parts, all the images they used are static and there's no way if the child can identify the same parts from self image.

Another famous app is Early Learning App For Kids[2] which has more than 500k+ downloads .

In this app, an art zone for children is put which is a basic painting module. The app is unable to identify shape and recognise characters for evaluation. Another problem of this app is the counting part where it used static images to teach counting but there's no part where a child can learn it from a live picture with more interest.

Now let's analyze a Bangla learning app named Bangla Kids Learning App[3] which has a number of downloads more than 500k+.


The app has some awesome features but as it's features are static they are no different from a

hard copy of a textbook. A child can hardly interact with such a static system.

We've analyzed many more apps available in the market and came to the conclusion that most of them use static features and not much of interactive for a child.

After analyzing the market of mobile applications, similar websites were also analyzed. Some notable websites are described below -

Sesamestreet[4]
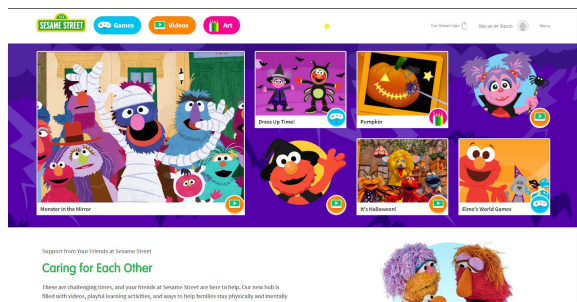
The website contains many beautiful animations, videos and games. A painting application is also available but there is no feature for writing and object detection to make learning more interactive.

Another famous website is scholastic[5].
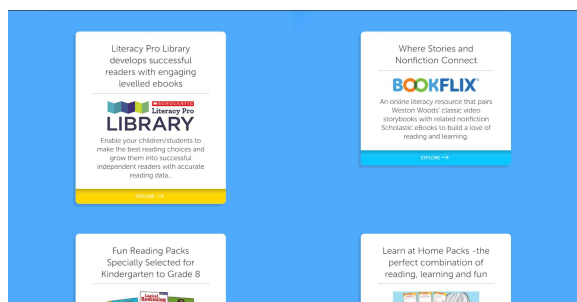
This is a paid website with a lot of labeled books. For children's learning, books play a vital role but this is also not much of an interactive solution.

Project Methodology

First let's talk about what we use
- Pycharm as IDE
- Python
- Django as web framework[11]
- Javascript, CSS and html for frontend
- Opencv
- Yolo model[6]
- Yolov3.cfg and Yolov3 weights[6]
- Yolov3-tiny.cfg & Yolov3-tiny.weights[6]
- Coco Dataset[7]
- Github
- Draw.Io for erd
- Anaconda as virtual environment
- Pillow [8]
- Numpy[9]
- Face_recognition[10]
- Dlib[12]

So now let's discuss how we make it. Let's talk about learning to write first. So the main idea is a child has to draw a character on the canvas. So here we use javascript and on selected event listeners. With the help of that by clicking on a mouse we make a paint application. With undo and clear features. In this application the image is saved which is used for character recognition in later stage.
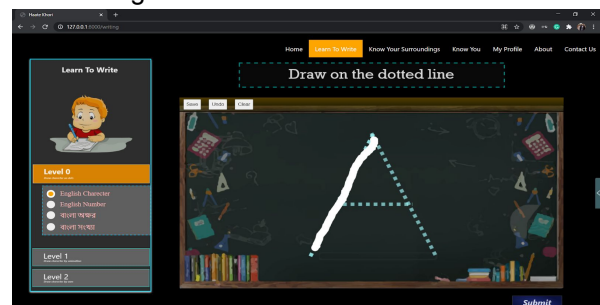

Moving on to the next we have known your surroundings that is the feature made of a combination of two things: shape and objects. In the shape part there are basically two parts: learn and identify.
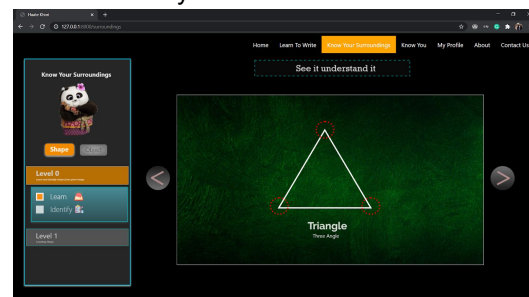

In the learning part the child will learn some basic shape with crucial identification points. Like for a triangle it must have three angles.

That kind of information is highlighted which will help the child in future to remember all the shapes. On the identifying shape part an image of multiple shapes is present on the screen. A shape is highlighted and the child has to choose the correct option.
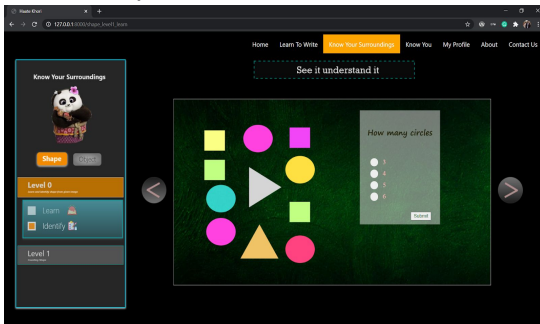

The choosing and showing result is made with the help of javascript. An alert is shown for right and wrong answers. The next part of the shape is the object. That kind of feature is implemented for baby to be make familiar with different nearby object like table, chair, car, person, banana, apple etc.
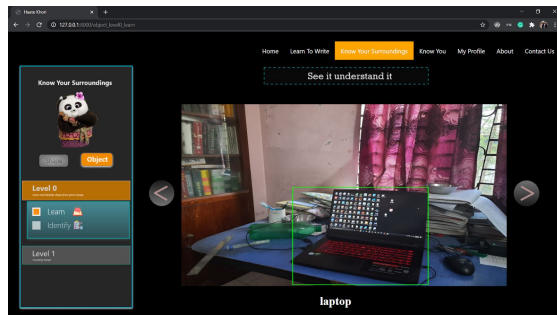

There are also two parts: one is learn and another is identify. It is made with the help of yolo object detection model. First we give an image our model identifies and sends it to the database. Then we retrieve it with a serializer and pass it to our template. Then with the help of json array and javascript we show the image and their corresponding object name. The main difference in identify part is that object name is not shown on the screen rather than it is stored to match with user input. Like others it also gives an alert for choosing right and wrong.
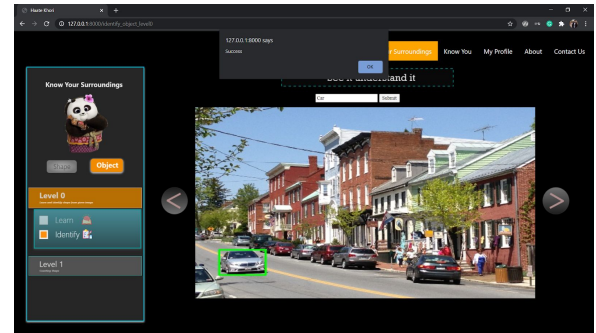
Our next feature is know you that is mainly divided into two parts one is know your relatives and another is know your body parts. To know your relatives we first take input from users a s known. For example you give an input of your father image and then from a group of images the child will learn who the child's father is. That kind of technique is very helpful for knowing child grandpa, grandma especially with whom children do not interact very often.
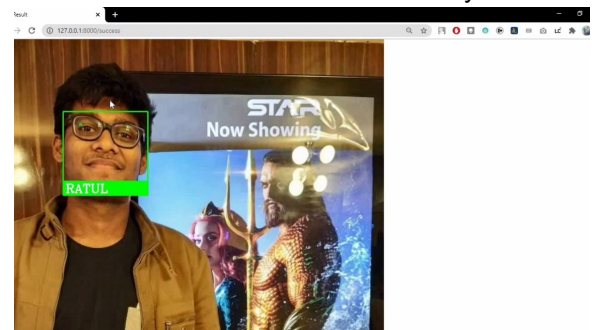
In the know your body parts. The child will put his/ her image in the system and our system will tell the child about the child's head, mouth, nose, eye etc. We all know we ask child babies to show me your nose, show me your eye, show me your head. In that kind of scenario our features will help the child.
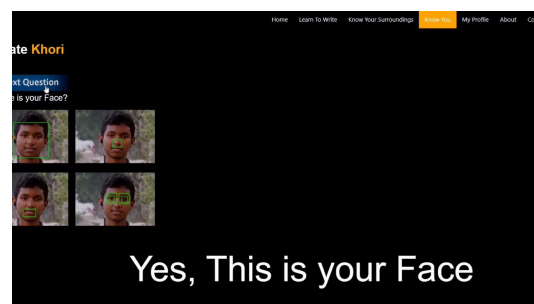
Result Analysis
Implementing these kinds of ml features offline is not a big problem for us. But the main problem

occurs when we want to connect them as in a web platform. But if we want analysis about our result.

In the ocr part we implement the handwritten character recognition. That is divided in english number, character and bangla number character. We can not make a huge test but as far as we test we get 75% accuracy for english characters. 80% accuracy for english numbers. But when we move on to bangla things become worse because we don't have a good dataset. Like for bangla characters it gives us accuracy about 40-50% for numbers around 50%. Another concern for us is that the writing is baby writing so it will not be straight; it can be manipulated by many parameters. Another thing is that we implemented the drawing part of the baby on the web platform and we can also generate png files. In our ocr part from the png file we can give output also. But there is a loophole. To use it on a web platform we have to pass the png file automatically to the model. We can not do it yet. We study a lot for this and we think we need to make some api to make this happen.

We have shape recognition and count that is fully implemented and gives an accuracy of nearly 98%.

So in the next part know your surroundings we have a nice result. We also implement our features in the web platform. Our model can find objects correctly 90% of the time. It gets confusing if we provide some cartoon image instead of real image. In this part we also make an application which can identify objects from live video or given video. It also has a very high frame rate around 25-30 fps for yolo-tiny.cfg and weights. Which is very ideal. But unfortunately to control video feed or give video from web platforms we have control devices at hardware level. To make this happen we have to create some api which is not possible for us yet. But we make it offline.

In our know you part we implement all the part of knowing your relatives on the web. We have to give an image where the face is clear. That is the drawback here.
In the last part we have body part recognition. Here we have problems with ear detection and we don't have good dataset here. Another problem here is that our model cannot identify the image if there is glass in the eyes. We also make it possible to implement these face recognition and body parts recognition in video feeds. But we can not implement the video feature on the web because we can not control the hardware part of the device.

Final thing is that for the covid period we can not manage a single computer or a server to install all of our features in a single place and make this happen in a single machine.

Challenges
We face a lot of challenges to implement these. The main challenge is to implement in the web platform like django. We have to learn javascript knowledge. So let's discuss some challenges.

In the know you surroundings part first we have to make a way to pass the image from the input to the model. We use a pillow and cv array converter to pass the image to the model. Then we have to figure out how we can save it to the database because the image is not possible to directly save. Another problem is an image will have multiple object images selected. The number of selected images is not defined. So we plan to save images separately with the object. To make this happen we use the default list of dictionaries[14][17] . Then our challenge is to use a unique filename. To solve this problem we use a number of iterations and a timeframe. Next challenge is we input a single image but multiple image file names have to be selected. The main image will be selected in another directory we have to solve this.

After that we have to retrieve the data and pass it to the database. That is not an easy task. Because to pass the data to the template means html file we have to convert them as json objects. To do that we use a python serializer and we jsondump it[15][16]. In the template and javascript part we face another challenge first time our data is not json parsable. We found that the data is a 4 layer of json object. To parse this correctly we have used parse json two times[18] [19]. Then we can use that. You may seem that is very easy but we have figured out all these solutions by reading full documentation and searching a lot of articles. Only one video is found that is relevant for us.

In the know you part we also face the same kind of problem converting offline ml code to web platform django code. It is a big big challenge for us. As we can not find any documents or resources. For example in the know you part we

have to take image input from the user store it with renaming on the server.

In the body part section we have a big challenge to find a dataset for babies and like the other two parts it is a big challenge to implement .

Future works
In future we want to learn how to make api. We think that if we can make an api we can implement all of our features in web and mobile platforms. As soon as we can meet we will implement it on a single machine.
We all know we feel the need of databases for our features. We have a plan to make a dataset in future if we can. We also have a plan to make a baby voice dataset and make a feature by which we can improve baby speaking tests also. As soon as we can make all the features together we will integrate the dynamic profile update system. You can found here what we done already

https://www.youtube.com/watch?v=bgcJx5GE2dc

Resources:
1. play.google.com/store/apps/details?id=com.greysprings.kindergarten8
2. https://play.google.com/store/apps/details?id=earlylearn.kidslearningworld
3. https://play.google.com/store/apps/details?id=com.urva.bengalikidsapp
4. https://www.sesamestreet.org/
5. https://scholastic.co.in/en/learn-at-home-all
6. https://pjreddie.com/darknet/yolo/
7. https://cocodataset.org/#home
8. https://pillow.readthedocs.io/en/stable/
9. https://numpy.org/
10. https://pypi.org/project/face-recognition/
11. https://docs.djangoproject.com/en/3.1/
12. https://pypi.org/project/dlib/
13. https://www.youtube.com/watch?v=9FNYmS4N30M
14. https://www.geeksforgeeks.org/defaultdict-in-python/
15. https://www.learnpython.org/en/Serialization
16. https://www.geeksforgeeks.org/json-dump-in-python/
17. https://pythonexamples.org/python-list-of-dictionaries/
18. https://www.w3schools.com/js/js_json_parse.asp
19. https://stackoverflow.com/questions/30194562/json-parse-not-working