Interactive Learning System for Schools Using Artificial Intelligence

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Abstract: *Interactive Learning platform for students utilizing AI Techniques and database-based solution. Interactive E-learning is essential to improve student engagement and flexible learning by utilizing digital technologies. Online and offline mode of classes are conducted in the many schools now due to after effects of COVID 19 pandemic, it is optional for school students. Our aim is to provide a web application which is relevant and interactive concepts for the school syllabus. A simple and easy to use interface would enable students and teachers to access the content on a web browser using mobile phones, laptops, and tablets. The purpose of this paper is to provide an interactive application which enables pupils to learn syllabus concepts which are assigned by their tutors. The platform is stored on the Database which maintains academic syllabus, students' profile, tutor notes and classroom recording. Additionally, a global search SMART engine based on artificial intelligence algorithm which would enable students to search the appropriate topics and other useful information and a handwritten letter & digits recognition using deep learning.*

1. Introduction

In online education system lack of interactive sessions or activities is one of the major drawbacks to restrict the students engaged to the application as compared to physical classes. For a tutor it is a challenging task to make the students understand the topic or lesson taught.

The Covid-19 pandemic that has lasted several months around the globe and has changed the order of life in the country from before, including the process of providing education. Following the Circular of the Minister of Education and Culture Number 2 of 2020 and Number 3 of 2020 concerning the Prevention and Management of Corona Virus Disease (Covid-19), learning is carried out online and working from home. This policy is intended to prevent and reduce the spread of Covid-19. This condition requires that many educational institutions at the primary, secondary and tertiary levels be responsive to this phenomenon.

Online distance learning is expected to emphasize more students' thoroughness and foresight in receiving, processing, and implementing information presented online (based on technology and communication). Accuracy and foresight are defined as forms of student independence in carrying out the learning process. Independent learning is a learning activity that does not depend on others where these students have their ideas and initiatives to determine goals, methods, learning resources, and evaluation of learning outcomes, and are responsible for themselves [7]. On the other hand, it was also stated by Panen that students who can learn independently are students who can control themselves, have high learning motivation, and believe that they have broad and flexible insights [8]. Apart from having the ability to control themselves well, students must also have a high motivation to learn to have good independence.

2. Literature Survey

[1] This paper Handwritten Digit Recognition Using CNN develop. The paper explains the issue of transcribed digit acknowledgment has for some time been an open issue in the field of example order. A few examined have demonstrated that Neural Network has an incredible execution in information arrangement. The fundamental target of this paper is to give effective and solid procedures to acknowledgment of transcribed numerical by looking at different existing arrangement models. This paper thinks about the exhibition of Convolutional Neural Network (CCN). Results demonstrate that CNN classifier beat over Neural Network with critical improved computational effectiveness without relinquishing execution. Handwritten digit recognition can be performed using the Convolutional neural network from Machine Learning. Using the MNIST (Modified National Institute of Standards and Technologies) database and compiling with the CNN gives the basic structure of my project development. So, basically to perform the model we need some libraries such as NumPy, 'Pandas', TensorFlow, Keras. These are the main structure on which my main project stands. MNIST data contains about 70, 000 images of handwritten digits from 0-9. So, it is a class 10 classification model. This dataset is divided into two parts i. e., Training and Test dataset. Image representation as 28*28 matrix where each cell contains grayscale pixel value.

[2] This paper The Perceptions of Primary School Teachers of Online Learning during the COVID-19 Pandemic Period: A Case Study in Indonesia. This study explores the perceptions of primary school teachers of online learning in a program developed in Indonesia called School from Home during the COVID-19 Pandemic. Data were collected through surveys and semi-structured interviews with 67 class teachers in primary schools. Data analysis used thematic analysis of qualitative data. The analysis results found four main themes, namely, instructional strategies, challenges, support, and motivation of teachers. This research contributes to the literature of online collaborative learning between teachers, parents, and schools that impact student success. Broadly, the success of online learning in Indonesia during the COVID-19 Pandemic was determined by the readiness of technology in line with the national humanist curriculum, support, and collaboration from all stakeholders, including government, schools, teachers, parents, and the community.

[3] This paper Implications for educational practice of the science of learning a development. Article draws out the implications for school and classroom practices of an emerging consensus about the science of learning and development, outlined in a recent synthesis of the research. Situating the review in a developmental systems framework, we synthesize evidence from the learning sciences and several branches of educational research regarding well-vetted strategies that support the kinds of relationships and learning opportunities needed to promote children's well-being, healthy development, and transferable learning. In addition, we review research regarding practices that can help educators respond to individual variability, address adversity, and support resilience, such that schools can enable all children to find positive pathways to adulthood.

[4] This paper Simulation Design and Development for Learning Seasons and Lunar Phases using HTM5, and JavaScript This paper presents our recent work in progress aiming to design effective learning simulations of day/night and seasons and lunar phases using web technology for K-12 Earth and Environmental science curriculum. Two interactive simulations using HTML5, JavaScript and CSS are developed with steerable parameters for students to interact and manipulate. The design and development details are discussed in this paper. We are currently in the process of designing the lesson plans with various investigations to engage students with the seasons and lunar phases concepts as well as assessments to evaluate their learning outcomes.

[5] This paper Integrating interactive computer simulations into K-12 earth and environmental science. This paper discusses our work in progress aiming to explore how computer simulations can be integrated into the K-12 curriculum of Earth and Environmental science. Several interactive simulations using Net logo, a multi-agent modeling environment, and Scratch, a visual programming software are being developed with steerable parameters and the corresponding output plots for students to manipulate and interpret the results, respectively. Here, we present two simulations we designed on water cycle and discuss how these may help students learn about the distribution of water and its continuous move in the ecosystem.
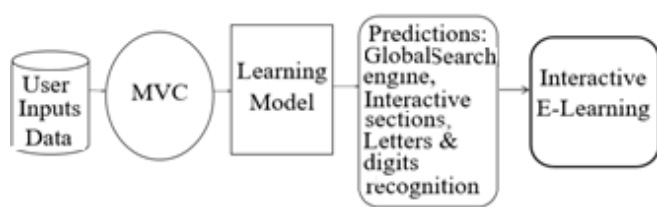
3. System Design

Figure 1: System Architecture

4. System Implementation

Dataset
In the first module, we developed the system to get the input dataset for the training and testing purpose. We have taken the dataset. Each row represents a single image of shape-> (1, 784) There are a total of 784 columns.

The first column contains the labels for each image:
Labels in map_images represent digits (0-9)
Labels in map_images represent letters (A-Z and a-b)

Importing the Necessary Libraries
We will be using Python language for this. First, we will import the necessary libraries such as Keras for building the main model, Sklearn for splitting the training and test data, PIL for converting the images into array of numbers and other libraries such as pandas, numpy, matplotlib and TensorFlow.

Retrieving the Images
We will retrieve the images and their labels. Then resize the images to (28, 28) as all images should have same size for recognition. Then convert the images into numpy array.

Splitting the Dataset
Split the dataset into training and testing.80% training data and 20% test data.

Convolutional Neural Networks
The objectives behind the first module of the course four are:
- To understand the convolution operation
- To understand the pooling operation
- Remembering the vocabulary used in convolutional neural networks (padding, stride, filter, etc.)
- Building a convolutional neural network for multi-class classification in image.

Computer Vision
Some of the computer vision problems which we will be solving in this article are:
1) Image classification
2) Object detection
3) Neural style transfer

One major problem with computer vision problems is that the input data can get big. Suppose an image is of the size 68 X 68 X 3. The input feature dimension then becomes 12, 288. This will be even bigger if we have larger images (say, of size 720 X 720 X 3). Now, if we pass such a big input to a neural network, the number of parameters will swell up to a HUGE number (depending on the number of hidden layers and hidden units). This will result in more computational and memory requirements – not something most of us can deal with.

Edge Detection Example
In the previous article, we saw that the early layers of a neural network detect edges from an image. Deeper layers might be able to detect the cause of the objects and even more deeper layers might detect the cause of complete objects (like a person's face). In this section, we will focus on how the edges can be detected from an image. Suppose we are given the below image.

Figure 2: Sample Image

As you can see, there are many vertical and horizontal edges in the image. The first thing to do is to detect these edges:
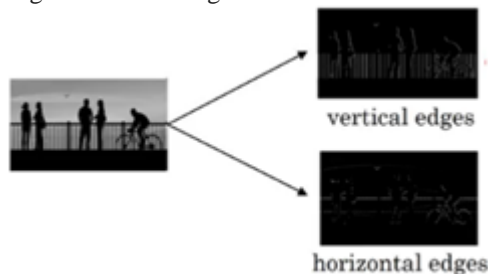

Figure 3: Edge Detection Vertical and Horizontal Edges

Building the Model

In Keras, models are defined as sequence of layers. We first initialize a 'Sequential Model' and then we add the layers with respective neurons in them. The following code does the same.

The model, as expected, takes 28 x 28 pixels (we flatten out the image and pass each of the pixel in a 1-D vector) as an input. The output of model must be a decision on one of the letters, so we set the output layer with 26 neurons (the decision is made in probabilities). Then we will add the layers to make convolutional neural network. In the first 2 Conv2D layers we have used 32 filters and the kernel size is (5, 5). In the MaxPool2D layer we have kept pool size (2, 2) which means it will select the maximum value of every 2 x 2 area of the image. By doing this dimension of the image will reduce by factor of 2. In dropout layer we have kept dropout rate = 0.25 that means 25% of neurons are removed randomly. We apply these 3 layers again with some change in parameters. Then we apply flatten layer to convert 2-D data to 1-D vector. This layer is followed by dense layer, dropout layer and dense layer again. The last dense layer outputs 47 nodes as the traffic signs are divided into 47 categories in our dataset. This layer uses the SoftMax activation function which gives probability value and predicts which of the 47 options has the highest probability.

Compile Model

Now that the model is defined, we can compile it. Compiling the model uses the efficient numerical libraries under the covers (the so-called backend) such as Theano or TensorFlow. Here, we specify some properties needed to train the network. By training, we are trying find the best set of weights to make the decision on the input. We must specify the loss function to use to evaluate a set of weights, the optimizer used to search through different weights for the network and any optional metrics we would like to collect and report during training.

Fit Model

Here, we train the model using a model check pointer, which will help us save the best model (best in terms of the metric we defined in the previous step).

Apply the Model and Plot the Graphs for Accuracy and Loss

We will compile the model and apply it using fit function. Then we will plot the graphs for accuracy and loss. We got average validation accuracy of 88.6% and average training accuracy of 89.3%.

Accuracy on Test Set

We got an accuracy of 88.7% on test set.

Saving the Trained Model

Once you're confident enough to take your trained and tested model into the production-ready environment, the first step is to save it into a. h5 or. pkl file using a library like pickle. Make sure you have pickle installed in your environment. Next, let's import the module and dump the model into. h5 file.

Import the Module

Create a connection function to run our code. Here we specify where we're connecting to, the user, the user's password, and then the database that we want to connect to. As a note, we use "localhost" as our host. This just means we will use the same server that this code is running on. You can connect to databases remotely as well, which can be neat. To do that, you would connect to a host by their IP, or their domain. To connect to a database remotely, you will need to first allow it from the remote database that will be accessed/ modified. Next, let's go ahead and edit our __init__. py file, adding a register function. For now, we'll keep it simple, mostly just to test our connection functionality. We allow for GET and POST but aren't handling it just yet. We're going to just try to run the imported connection function, which returns c and conn (cursor and connection objects). If the connection is successful, we just have the page say okay, otherwise it will output the error.

5. Future Scope

In the future, the desirable AI system would shape students' imagination and creativity, analyzing their learning style and emotional condition and initiative, to improve learning capabilities and creativity and stimulate subjective initiative. AI systems are likely to be used more widely, which is expected to thrive on all aspects of students, i. e., personal skill, knowledge mastery, learning ability and career development instead of just assisting students in understanding of specific knowledge.

5.1 Functional Scope

- Include more modules like
- Students 360-degree view with overall development of student and
- Integrate Financial Department.

5.2 Technical Scope

- Increase Data capacity and enhance interactive concepts for each level of standard.
- Maintenance of large amount of data can be handled and
- Enhance the data learning using LSTM technique.

6.   Conclusion

In this paper, our system is designed and implemented using open-source technologies to achieve greater reliability and scalability. We provide a user-friendly web interface for teachers to manage their classes and virtually teach concepts in a systematic approach. Also, students can access their course/book material and learn via interactive simulations at any time using a Web browser. This study presents an effective teaching method for online teaching. During online teaching, teachers guide, check and manage student's study by different kind of problems or questions while students acquire knowledge by answering and solving problems. students to share their experiences in this unprecedented, new educational environment. They were able to share what difficulties they faced, what digital competencies they would need to develop. They could give suggestions and solutions for improving the quality of education, thus helping their educators in connection with the development of digital teaching materials and interactive AI implemented tools and sections for student learning. They could say how prepared they felt individually and technically, and how motivated they were to stay in digital education and interactive AI implemented tools and sections for student learning like global search for knowledge gain and hand digits & letters recognition for school children. further we increase our AI would shape students' imagination and creativity, analyzing their learning style and emotional condition and initiative, to improve learning capabilities and creativity and stimulate subjective initiative. AI systems are likely to be used more widely, which is expected to thrive on all aspects of students, i. e., personal skill, knowledge mastery, learning ability and career development instead of just assisting students in understanding of specific knowledge.

References

[1] Mayank Jain, Gagandeep Kaur, Muhammad Parvez Quamar and Harshit Gupta, "Handwritten Digit Recognition Using CNN" DOI: 10.1109/ICIPTM52218.2021.9388351

[2] R. Rasmitadila et al., "The Perceptions of Primary School Teachers of Online Learning during the COVID-19 Pandemic Period: A Case Study in Indonesia, " J Ethn Cult Stud, vol.7, no.2, p.90, Jul.2020, doi: 10.29333/ejecs/388.

[3] I. Fauzi and I. H. Sastra Khusuma, "Teachers' Elementary School in Online Learning of COVID-19 Pandemic Conditions, " ji, vol.5, no.1, pp.58–70, Jun.2020, doi: 10.25217/ji. v5i1.914.

[4] M. Mailizar, A. Almanthari, S. Maulina, and S. Bruce, "Secondary School Mathematics Teachers' Views on E-learning Implementation Barriers during the COVID-19 Pandemic: The Case of Indonesia, " EURASIA J Math Sci Tech Ed, vol.16, no.7, p. em1860, May 2020, doi: 10.29333/ejmste/8240.

[5] S. Kushner Gadarian, S. W. Goodman, and T. B. Pepinsky, "Partisanship, Health Behavior, and Policy Attitudes in the Early Stages of the COVID-19 Pandemic, " SSRN Journal, 2020, doi: 10.2139/ssrn.3562796.

[6] A. Latip, "Peran Literasi Teknologi Informasi Dan Komunikasi Pada Pembelajaran Jarak Jauh di Masa Pandemi Covid-19, " EduTeach: Jurnal Edukasi dan Teknologi Pembelajaran, vol.1, no.2, Jun.2020.

[7] A. D. Dumford and A. L. Miller, "Online learning in higher education: exploring advantages and disadvantages for engagement, " J Comput High Educ, vol.30, no.3, pp.452–465, Dec.2018, doi: 10.1007/s12528-018-9179-z.

[8] Rutten, N., van Joolingen, W. R., & van der Veen, J. T. (2012). The learning effects of computer simulations in science education. Computers & Education, 58 (1), 136–153

[9] Beheshti, E., Weintrop, D., Swanson, H., Orton, K., Horn, M. S., Jona, K., & Wilensky, U. (2017). Computational Thinking in Practice: How STEM Professionals Use CT in Their Work. American Education Research Association, San Antonio, Texas.

[10] Swaid, Samar. (2015). Bringing Computational Thinking to STEM Education. Procedia Manufacturing.

[11] ACMES: Assimilating Computational and Mathematical Thinking into Earth and Environment Science – http: //app. acmes. online

[12] Zhu, M., Panorkou, N., Lal, P., Etikyala, S., Germia, E., Iranah, P., Samanthula, B. K., and Basu, D. . (2018). Integrating interactive computer simulations into K-12 earth and environmental science. Proceedings of IEEE Integrated STEM Education Conference (ISEC), Princeton, pp.220 – 223.

[13] Zhu, M., Gulati, S., and Panorkou N. (2019). Simulation Design and Development for Learning Seasons and Lunar Phases using HTML5 and JavaScript.2019 IEEE Integrated STEM Education Conference (ISEC), Princeton, NJ, USA, 2019, pp.414-418.

[14] Wilensky, U. (1999). NetLogo. (http: //ccl. northwestern. edu/netlogo/). Center for Connected Learning and Computer-Based Modeling, Northwestern University, IL.

[15] Maloney, J., Resnick, M., Rusk, N., Silverman, B., and Eastmond, E. (2010). The scratch programming language and environment. ACM Transactions on Computing Education, 10 (4), Article 16.

[16] Armbrust, M., Fox, A., Griffith, R., Joseph, A., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I., & Zaharia, M. (2010). A view of cloud computing. Comm. of ACM, vol.53, pp.50–58.

[17] Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., and Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences of the United States of America, 8410-5.

[18] L. Darling-Hammond, L. Flook, C. Cook-Harvey, B. Barron, and D. Osher, "Implications for educational practice of the science of learning and development, "

Applied Developmental Science, vol.24, no.2, pp.97–140, Apr.2020, doi: 10.1080/10888691.2018.1537791.

[19] I. Hidayah and Sugiarto, "Model of Independent Working Group of Teacher and its Effectiveness towards the Elementary School Teacher's Ability in Conducting Mathematics Learning, " Procedia-Social and Behavioral Sciences, vol.214, pp.43–50, Dec.2015, doi: 10.1016/j. sbspro.2015.11.591.

[20] D. Dewantara, M. Wati, Misbah, S. Mahtari, and S. Haryandi, "Blended Learning to Improve Learning Outcomes in Digital Electronics Courses, " presented at the 1st South Borneo International Conference on Sport Science and Education (SBICSSE 2019), Banjarmasin, Indonesia, 2020, doi: 10.2991/assehr. k.200219.054.