**Essay Grading Using Hidden Markov Method and Bidirectional Recurrent Neural Network**

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**Abstract** - Evaluation of an English essay is one of the important and complex tasks which is done manually by skilled and efficient professors and faculties till date. With the growth of science and technology, we can simply automate the evaluation task by using state of the art natural language processing techniques. The project acts as an intelligent system - built upon multiple neural network model - gives out generic evaluation for any given English essay.

**Index Terms** – Neural network model, intelligent system, generic evaluation.

1. **Introduction**

International examinations like GRE (Graduate Record Examination), IELTS (International English Language Testing Systems), etc., is gaining popularity day by day as this examination’s results are considered as criteria for various universities and companies. Therefore, the number of students who are taking the exams increases day by day and there is a huge time buffer to evaluate their English essays and publish the results. To reduce the stress on the organization who are hosting these examinations and students to practice their writing skills, our project aims to evaluate the English essay so that the organization can focus their work in other aspects of examinations and students can practice at free will.

1. **Logical Project Flow**

The main goal of the project is achieving the five crucial factors for evaluating an English essay. The factors are

1. Grammar and spell check.
2. Sentence complexity.
3. Style continuity.
4. Usage of advanced lexical resources.
5. Coherence and cohesion.

The above-mentioned factors are checked by developing a dedicated model for each factor having the input of the whole essay. The primary services of the project (evaluation engine which evaluates the essay) is hosted in any public clouds so that organizations can utilize our services too. Since there are 5 generic factors involved in evaluation of an essay, we will develop 5 neural network model which evaluates on its each of the factor.

Model 1 – Grammar and spell check.

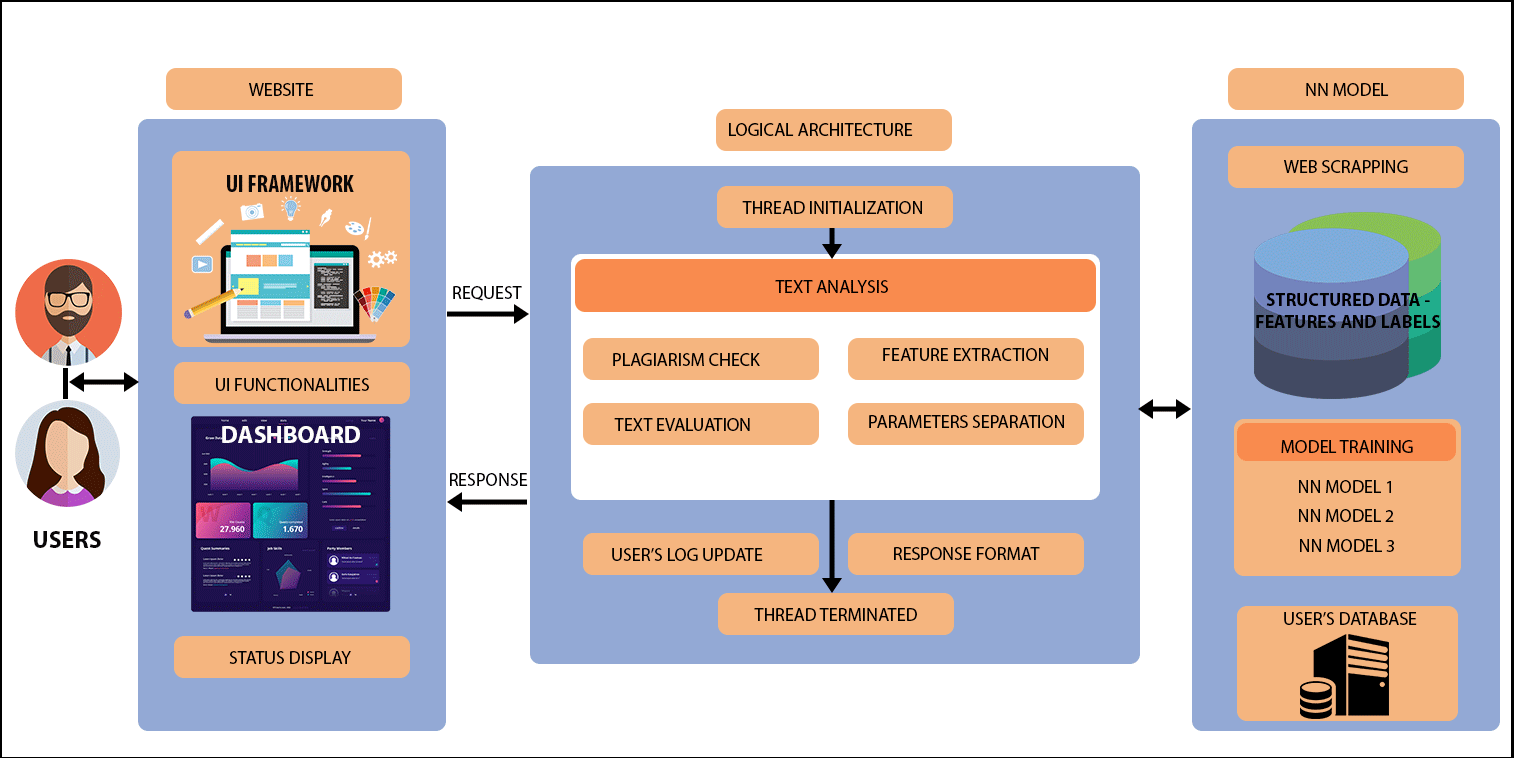
Model 2 – Sentence complexity.

Model 3 – Style continuity.

Model 4 – Lexical Resources.

Model 5 – Coherence and cohesion.

The architecture of the project is as given in *Figure 1*.



*Figure 1*

**Evaluation Algorithm**

The Models which we are developing using different strategies to calculate the scores of each factor required by the project

**Model 1** mainly classifies multiple sentences in the paragraph as correct or wrong. The classification mainly revolves around 2 factors. First factor is spelling mistake and second is grammatical errors in that sentence. Using rule based Hidden Markov Model (HMM) [1] to find Parts-Of-Speech (POS) tags of a single English sentence from the essay. Using dictionary method and N-gram technique [2] to find the misspelled word and totally irrelated word which is not present in the English dictionary. When the sentence is classified as a perfect sentence or not, we calculate the percentage of correctness by

Correctness score =

Correctness score will range from [0-10]

**Model 2** predicts how well the sentence is structured and expressed in higher standards. For example, take the phases “I know everything” and “No secret lies beyond my grasp” conveys the same meaning but the 2nd phase specifically conveys the message that he is a high level English user and thus 2nd phase should receive more score than the first phase. Data is scrapped from the internet and it segregated into 3 buckets namely bucket 1,2,3. The project utilizes Word level embedding, LSTM and Bidirectional Recurrent Neural Network (BRNN) [3]. Hence, we have 3 hidden layers each layer doing different mathematical operation to produce a necessary output. When the neural network is trained, a vector will be produced for the given input word. This vector will be compared to the three bags and the nearest bag vector value is considered and the output is given.

**Reference**

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