Control-Ef: A Transcript Search System based on Spring MVC Architecture

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***Abstract*—Emotion is the most instinctive feeling of a human. In order for computers or virtual assistants to interact successfully with humans, it is very important to make computers understand their emotions. Electroencephalograph (EEG) signals provides a convenient, non-intrusive, and accurate way of capturing brain signals in multiple channels at fine temporal resolution. In this paper, an end-to-end deep learning method is proposed to extract features and recognize emotion from raw EEG signals. We implemented and compared the performance of two popular sequence algorithms which are LSTM and TCN. These algorithms are used to model the EEG signal from a publicly available dataset to predict the score of arousal and valence. We then applied a classification method to classify those scores into emotions. Our results show promising results for the TCN model, with the lowest MSE loss. Additionally, the TCN model proved to perform much better than the LSTM, implying that it should be the preferred method for realtime emotion recognition.**

***Index Terms*—Control-Ef, transcripts, search engine optimization**

I. Introduction

Many countries around the world have migrated from traditional face-to-face education to online education with the outbreak of COVID19 pandemic [1]. Recorded videos of lectures are considered as an important educational strategy in such contexts that could potentially improve the breadth and depth of students' learning since it allows students to recall the educational content [2]. However, the overload of information is also witnessed in return that daunt the students to find the appropriate content [2] and the specific content of their interest.

When there is only a limited time for preparing for an examination, watching the entire video of a recorded lecture is quite critical and time-consuming. In that context, the Search Engine Optimization, the search, and navigation to the specific content within the video would assist the students to learn the specific information within a short period of time. Many case studies have also proved that the Search Engine Optimization leverage the students positively towards learning [3]. The availability of transcripts of video lectures helps both hearing impaired and non-native speakers of English in addition to providing an efficient search. [3].

This paper introduces a transcript search system named Control-Ef based on Spring MVC Architecture that assist the students in learning. The objectives of this system are twofold: to help students search and obtain their desired video and to assist in navigating to the exact timestamp with the desired content within the video. Furthermore, the main architectural challenge that this study tries to solve is the performance of the system as it scales up. The actual problems of the students in learning through recorded video is analyzed and designed based on the Software Design paradigm.

The basic workflow of the system is designed using three-tier structure of Spring MVC architecture. The system is set up using Spring Boot and implemented using Java and the database platform is Postgresql. Video playing and transcript support is carried out via the YouTube API. Only video metadata and the transcripts themselves will be recorded in the system's database. This means that the focus of our system performance lies in the querying of transcript data and not in the accessing or processing of videos. This is one major point that the reader should keep in mind and that this study attempts to solve.

The developed system assists the students in multitude of ways that helps them comprehend the content of the video, improves the accessibility and makes the learning more engaging and more specific.

II. Related Works

A. Online Learning and Video Transcripts

A video system that stores and manages the video resources has been developed by [4] which is based on MVC framework. This system also supports authority management and security. The author proposes that MVC framework is the appropriate architectural pattern in developing a system that enables the users to upload, view and download video contents. Some of the popular Open Course Ware (OCW) resources such as [5] and [6] incorporated several innovative digital affordances to improve learning. Availability of video transcripts is a core feature in both of these platforms. A survey on these two OCW platforms [3] proved that the video transcripts provide integrated learning experience and helps to translate between languages.

In another study [7], the visual transcripts have been used to improve the quality of learning through video lectures. This system provides the visual transcript and text in a linear layout to enable students to browse or search through the videos. However, this work is quite limited to only blackboard style teaching. Zoom is another video-conferencing platform that provides automatic audio transcription for the cloud recordings of its meeting [8]. The transcript is also divided into sections with timestamps that lets the users to navigate to the searched keyword. However, this is application specific and available only to Zoom meetings.

B. Software Architecture Patterns

The major focus of this study is the performance of transcript searches. Hence, a short review of big data architectures has been conducted to choose appropriate architecture for the system that could handle speedy searches across a bulk of transcripts. [9] utilized Apache HBase as a distributed datastore for millions of clinical data records from IoT devices as shown in Figure 1. Hbase was chosen due to its ability to scale horizontally in a distributed manner.

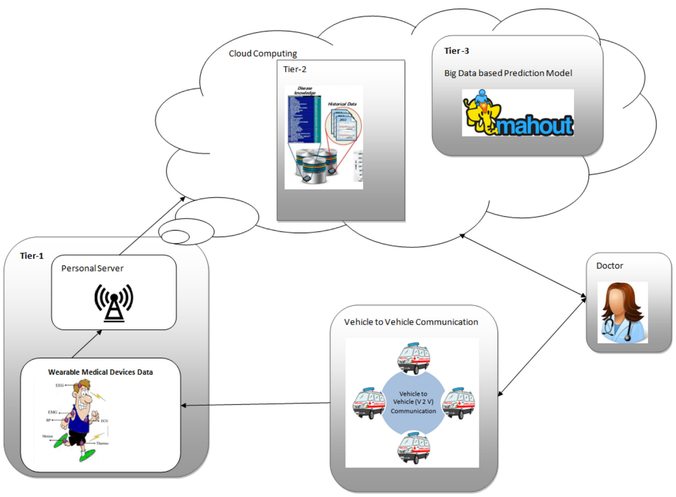

Fig. 1. Architecture as proposed by Kumar et. al. [9]. The relevant HBase component is in Tier 2.

Another study by [10] also used Apache Hbase as a large-scale datastore, in this case storing large volumes of video metadata. The metadata of Control-Ef is stored in a relational Postgresql database. In addition to metadata, they also stored the actual raw video data on an HDFS Hadoop system whereas our system has used YouTube to store the videos.

In another study [11], the authors proposed a system once again for IoT data acquisition in which Apache Cassandra, a non-relational column datastore, was used to store large amounts of sensor data with a focus on high availability. A multi-node Cassandra cluster was setup for their study. Apache Cassandra was chosen because it offers high availability, scalability and fault tolerance. Their architecture is shown in Figure .

III. Design and Implementation

The Control-Ef system has been implemented to overcome the challenges encountered in existing transcript search systems. This system is lightweight in nature and has improved performance over its predecessors. Since the YouTube API is used for both the video player and transcript generator, the system is faster as much of the processing has been outsourced to a separate service, i.e. YouTube in this case. As this system does not make an API call to a separate transcript generation, the communication and administrative overhead such as extra API calls, API key management, etc are reduced. However, one major disadvantage lies in the fact that this system is highly reliant on YouTube and suffers from the risk of Single Point of Failure.

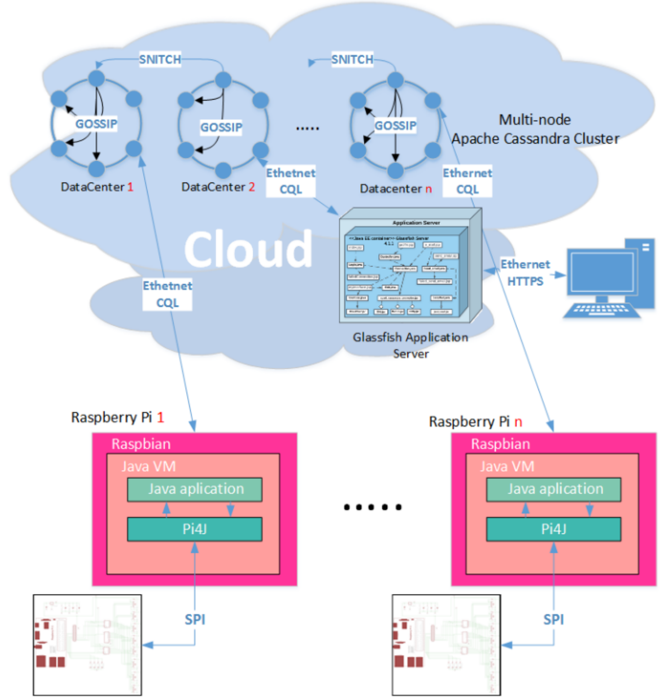

Fig. 1. System arhitecture

Fig. 2. System architecture of Ferencz et. al. [11].

A. Architecture

Since the transcript generated is of high volume and highly unstructured, one of the main goal of the system was to choose an architecture that can provide a speedy response to the query made by the user, in this context is the provision of exact timestamp of the keyword searched when multitude of users are logged in and many videos with similar keywords exist in the system. Thus, choosing a distributed, scalable management system to support big data generated was crucial. The data storage component chosen was multi-node Apache Cassandra cluster as all the nodes in the cluster is able to perform all read-write operations [12]. Thus, the architecture of Control-Ef is woven around Apache Cassandra to provide improved performance and resiliency to the system as shown in Figure 3.

The video metadata and user data will be stored in the PostgreSQL database. The two key challenges are the possibility of automatic scaling across multiple nodes and the supportability of Cassandra to the structure of timestamp.

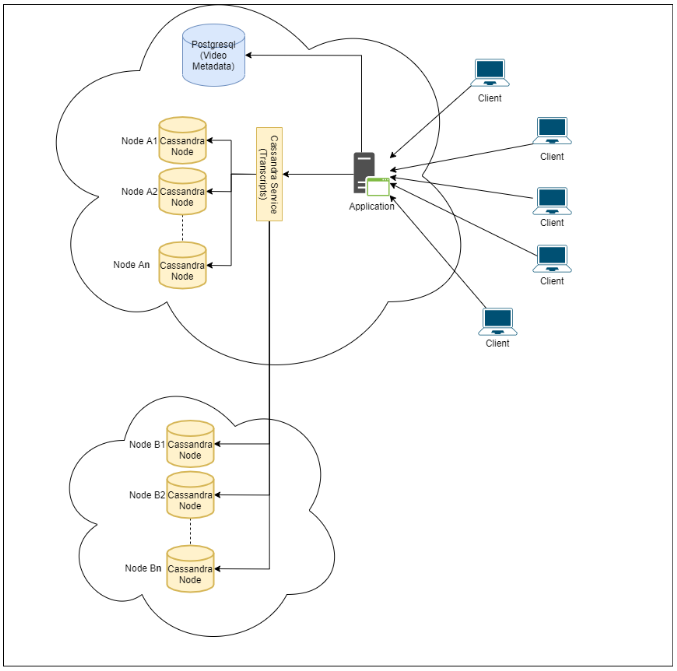

Fig. 3. Proposed System Architecture.

B. Experimental Design

The goal of this system is to provide a fast search **response time** for students to study from recorded videos. **Response time** refers to the time taken for a user to receive a response from the system on the user interface. Therefore, a test has been designed to study the response times of the system under various conditions. The plan is to simulate an increase in the number of transcript data entries in the Cassandra cluster until it reach 5000 entries. This can be accommodated with a far fewer number of videos since a video can have multiple entries for the timestamps. The rate of change in the response time of the system's transcript search can then be estimated as the number of entries as the system increases. The goal of the test is to maintain the maximum response time of five seconds regardless of the number of entries in the system. The graphical illustration of the expected outcome is shown in Figure 4.

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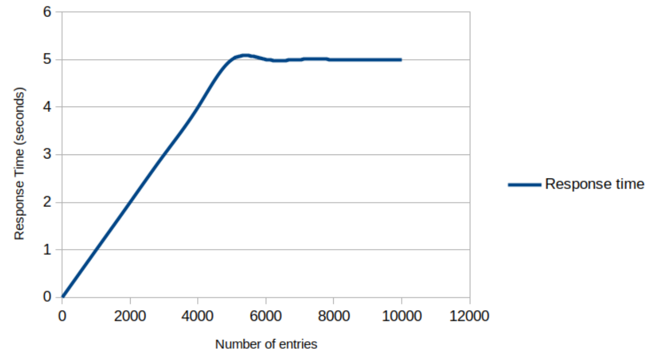

Fig. 4. Expected Outcome of the test.

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