Multimed Tools Appl (2018) 77:5003–5026
DOI 10.1007/s11042-017-4615-z

Multimedia based student-teacher smart interaction framework using multi-agents in eLearning

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Received: 23 June 2016 / Revised: 19 September 2016 / Accepted: 16 March 2017 /
Published online: 29 April 2017

Abstract Multimedia content comprises the graphics, audio & video clips, animation and text to present learning materials in a style, which improves learner expectation in eLearning paradigm. Electronic learning gained the popularity due to its immense coverage of students and subjects all over the world. The aim of this study is enhancements using agent-based framework through multimedia data in eLearning paradigm. Analysis of multimedia contents and eLearning data are helpful for the course designers, teachers, and administrators of eLearning environments to hunt for undetected patterns and underlying data in learning processes. This research improves the learning curves for the students. It also needs to improve the overall processes in eLearning paradigm. Information and Communication Technologies supported education, and virtual classrooms environments are mandatory. In eLearning data is evolving day by day that includes the semi-structured data, unstructured data, and structured data which is also collectively marked as multimedia big data. Multimedia data has the potential to mining for the analytics and learning. The learning outcomes for the students are very important to find the facts that what impacts the input data on the student. There are

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1108 students posted questions in online Learning Management System (LMS) and instructors reply these queries. Sensor data is also gathered by the mobile GPS to find the student location. The system has analyzed the relevance of the replied answers. The student satisfaction is achieved by providing the multimedia-based student-teacher interaction. This can lead to synchronous communication and multimedia content conversation in eLearning paradigm. Machine learning techniques are applied to that data to discover the patterns and behavioral trends. It can also be used in the eLearning environments for the teacher to assist and enhance the pedagogical skills and for student's learning curve enhancements.

Keywords eLearning · Machine learning · Multimedia data · Text mining · Multimedia application

1 Introduction

Electronic Learning (eLearning) plays the role global for both local and worldwide students to open the door for new opportunities in undergraduate and higher education. Interaction among the students (student-student) is important but the interaction between teacher and student (teacher-student) always key factor towards effective learning. To make eLearning more efficient, it requires intelligent tool and techniques for the simulation of the e-contents. Information technology can be used to support the eLearning paradigm, which boosted the student's learning curve. In eLearning data is evolving day by day and becoming a huge amount that includes the structured data, unstructured data, and semi-structured data, which is also marked as multimedia big data. Multimedia data has the potential to mining for the analytics and learning. The Internet provides the facilities that were not present before 10 years now students can learn from eLearning by using a smartphone, workspace or even if they are at their home. Data Scientists in terms of volume at any percentage shows up a fantastic good list of things to mining. Reasonably, the huge information which is similar to the case for IT enrollment overall and in development [24]. The key devices of science incorporate sensors, sensor systems, databases, information mining, machine learning, data visualization, and clustering at a massive scale as spearheaded for different purposes by organizations, for example, Google and Amazon. These organizations have made entirely new standards by catching huge volumes of information, digging it for new learning. Moreover, making it open accessible on the World Wide Web in useful ways, changing how individuals discover and make utilization of data regularly. The same advancements are serving to introduce the period of e-Science. It significantly more than computational science represents the degree, boosts in all fields of science and building are hitched to advances in PC science and the scientific sciences.

To abridge the incredible flow of data, the drive process for areas "signals, audio, video, sensors and imaging data" are established. The incredible flow of data in signals, audio, video, sensors and imaging research field are contemporary [18]. The fields of machine interfaces, sound observation in telemonitoring, delicate tissue exposing and body sensors have been a hot issue. The segment can just mirror a little parcel of the productive overall work in the field of signals, audio, video, sensors and picture transforming with applications in multimedia as shown in Fig. 1. The data in the Enterprise resource planning system is MBs, customer relationship management systems are having data in GBs, while in the web data growing TBs and big data has volume in Peta bytes. Then progress in this area might emphatically influence future consideration. Multimedia data composed of a variety of content. Due to recent development, unlimited datasets are to

be transparently accessible because of expansion in client produced information delivered by the advancements using Web 2.0 [8, 19]. This sort of information that is being produced additionally bigger segments, for example, sites, tweets, and wikis. Tim Berners-Lee has proposed that current and coming era of Web seek to be referred as "Information Web" [6]. To emphasize the significance of the part that information is relied upon to production. In fact, web information is severely underutilized, e.g. 97% of clients never look past the main three indexed lists [22]. Many intentionally created records are never even taken a look. Web Semantic contains a valuable knowledge asset and is regularly indicated to as "Web Intelligence" [23]. This knowledge needs to be separated and used. Artificial Intelligence is an impeccable apparatus for fulfilling knowledge goal. Web 2.0 was considered to empower the information generation and the Web 3.0 will be to empower the dealing of this information.

For the effective communication between student and teacher, multimedia content delivery is very important. Multimedia contents are produced on large scale and freely available on the internet. Multimedia databases with due challenges of security, content management, information retrieval, transmission, and mining [17]. This exponential growth provides a lot of opportunities for the data scientists to explore this data to find the useful patterns and trends. The eLearning system also required the trusted model for the educational institutes to supports the cloud services [4]. The huge volume of eLearning multimedia contents are available as Open Education Resources(OER) for students [7]. Intelligent algorithm for the processing of the multimedia data video, audio, images and sensor data are required with new representational forms.

Question answering is the backbone for any learning system and especially plays a key role in eLearning paradigm [13]. It is an important feature of the eLearning environment that facilitate the student to continuously improve the learning skills [3]. In asynchronous mode, students have, limited facility to post their queries through LMS based interface. These queries are commonly text based and no multimedia facility is available. In proposed model student, queries are answered automatically by agent-based question answering system. Selected queries locked by the system are answered by the teacher. Teacher reply is also containing the excessive text with

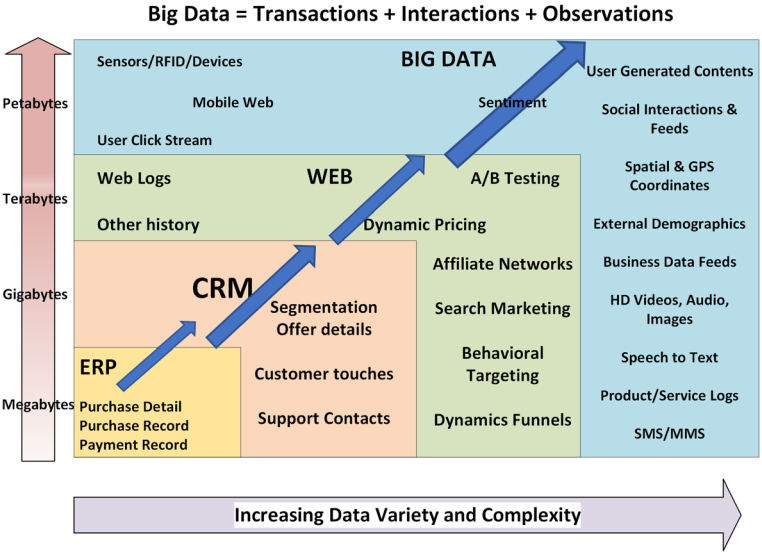

Fig. 1 Multimedia Big Data particular levels [1]

graphics are optional. Therefore, there is a strict need to introduce a framework for the student-teacher interaction that provides the multimedia-based communication to satisfy the student queries. The entire student having interaction through multimedia-based setup is very costly and sometimes impossible to handle such scenario as limited bandwidth and other managerial and resources limitations. In the given scenario some multimedia based framework will be designed that automatically facilitate the student and teacher to communicate if required hen fixed the appointment and student may communicate to the teacher.

2 Literature review

The demand for eLearning is increasing with the acceptance and adoption of Internet in the recent decade [2]. eLearning represents an almost ideal approach for a flexible and cost-effective competence development, as it can be used without restrictions related to physical location and time of usage [5]. The Internet provides the facilities that were not present before 10 years and now students can study from eLearning resources by using a smartphone at any workspace or at their home [5]. As in real-time environment, time zones are in education question answering approach is being used from a long time but quality of return answer to a student is yet not being achieved [2, 3, 5, 6, 8]. In this regard, different approaches like natural language processing also try to help at a certain level to achieve real-time demand because of huge computing [5]. If the time zone is not considered then anytime, anywhere, students query answering become tougher [13, 21, 22, 24].

The focus to eliminate the gap of questioning answer between student and instructor by asynchronous QA system [24]. That is based on instructor feedback, which is being validated by the proposed system and suitable for both distances learning and the asynchronous online environment by merging this solution in existing management scenario [21]. This scenario prevents students from unnecessary tension in getting their reply in a scenario in which teacher is not physically present [24]. To shorten incredible flow of research in the field of signals, audio, video, sensors and imaging informatics is ongoing [15]. It may result in the determination process for this area “signals, audio, video, sensors and imaging informatics" which carried out brilliant articles, speaking to research in four separate countries. The fields of cerebrum machine interfaces, sound observation in telemonitoring, delicate tissue exposing and body sensors have been chosen [6, 13]. The segment can just mirror a little parcel of the productive overall work in the field of signals, audio, video, sensors and picture transforming with applications in stimulating informatics [17]. Then progress in this area might emphatically influence future patient consideration [1].

Machine learning techniques are very useful for the question answering systems [12]. Machine learning approach is used for the classification of the question answering. They consider lexical, semantic and syntactical features of the question to predict its type by considering question headword and semantic headword features [12]. Different classifiers including Support Vector Machines (SVM), Naïve Bayes (NB), and Nearest Neighbors (NN) can be used with a bag of n-grams and bag-of-words features [20]. The proposed model is a supervised learning classification problem0which proved the combination of unigrams, question category, word shapes, question headword, and the semantic headword feature. They achieved 96.2% & 91.1% accuracy by using Support Vector Machines with semantic, syntactic & lexical features. Results are also tested on UIUC dataset to ensure accuracy [11].

The eLearning framework must have the capability to integrate multimedia contents picture, animation, audio, video, graphics and text to promote the learner reading interests and enthusiasm

[21]. Multimedia contents enhance the learner experience due to variety in contents. Multimedia data contain the video clips, audio clips, tutorials, animations, text and graphics to improve the learning curve of the students. Individual can better learn by using the multimedia contents [5]. Naseer in 2014 presents a model for the cloud service users based on the last one year dataset taken from the regulatory authorities. It provides the trusted model for learning to the education intitutes [4, 14]. Web documents provide the eye-catching sophisticated designs and organization of the multimedia contents for the learners. Course data can be more useful for the students in online scenarios enhance the productivity and effectiveness by mixing the multimedia materials [17]. Multimedia contents are having an attribute to better delivery and performance. These attribute a play vital role in supporting student skill in eLearning paradigm [21]. Khaid with others proposed novel quantization approach. Which generates the features vocabulary for the space representation of shapes [9]. Figure 2 present the multimedia attributes mandatory in the eLearning system. A novel multi-label classifier ensemble method that meets the experimental and computational requirement of the BIOASQ that is a QA challenge in biomedical semantic indexing which satisfies the performance of the baseline models. Although experimental results show a significant change in the baseline model well its good in noticing a trend in literature, and changing meaning in respect of the trained machine learning algorithm like hidden distribution changes [16].

The semantic web is designed to represent the concepts on World Wide Web by using the Resource Description Framework (RDF) [11]. To cope up The Web Ontology Language (OWL) [10] Definition Language (DL) ontology with containing a huge amount of data is a challenge for today [10, 11]. Due to large complexity of the data, a small portion is being used by the application developers that are not sufficient for the given input that is why not all but some of the queries and dataset are wrongly being answered [19]. Finding precise answer of the query, first of all, to retrieve information that is the upper bound of QA system performance. In the proposed scheme of the paper author, use phrases that automatically detect the question exact match related to posted query [12]. Evolution of verb, prepositions, and noun phrases is carried out in documental retrieval query that improves that overall IR performance on web data. These techniques are also successful for using phrases on the smaller closed set of data as it is an accurate indicator for candidate sentence than words [20].

3 Research methodology

The collaborations happen when learner make utilization of considerable customary stuff assets, for example, course readings, reports, research constituents, features, sounds and other learning materials. In the setting of a Learning Environments, they are typically connected with scanning and getting to the diverse knowledge. Data Mining is the process of extracting the

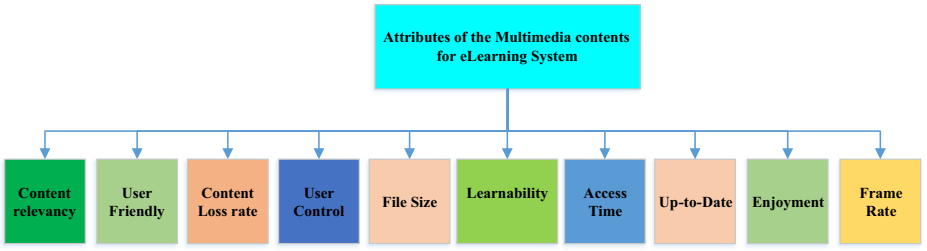

Fig. 2 Attributes of the Multimedia contents for eLearning System

initially unknown, potentially valuable facts, trends, and pattern. Data mining discovers the facts and patterns which may be unexpected. The patterns and trends from the big data are possibly very useful for the future learning and enhancements. Sometimes, it also finds the outliers, which are more essential to confine the organizational and learning decisions. The extracted information is may be implicit and previously unknown to the learner. It can be done by the use of some machine learning techniques and algorithms like ANN [15]. The semi-automatic or automatic resources are possibly carrying it out. The tools can process the large amount of data like big data that is generated in the form of audio, videos, sensor data, text, images and transaction data. Data Mining tasks are divided into two main categories one of them is predictive, and other is descriptive as shown in Table 1.

There is a number of sensors are available in daily operational devices like mobile phones, smart watches, etc. The human body has a different type of sensors that plays a vital role in the learning process. It also depends on the extent of the sensor, like what information they can percept from the environments. The learning of any animals and human is directly proportional to their body sensors. The body sensor may divide into different categories like eyesight, hearing, touching, smelling and taste. The most powerful among these are eyesight and hearing that plays the most influential part of the human being learns, learns most of the time uses these senses for the enhancement of the new fact learning.

The person senses the sound wave and extracts the different word sounds as for the verbal communication by considering pronunciation. On the other hand, if the student is watching a video running on the television or computer monitor or LCD screen. He can extract image frames one by one, that are continuously being stored in short term memory while potentially valuable frames are stored in long term memory after the comparison and integration of the extracted data with previous related data. It is done by building a new network that leads to future concerns. While simultaneously the audio waves that are extracted from the running video is also mapped with image frames. Then the video stored by using the "divide and conquer" strategy. This pictorial format and audio segment are fully integrated.

The proposed solution is based on multimedia data for the eLearning systems. This solution is agent based to facilitate the student and utilization of the resources efficiently. Text Mining comprises of the pattern discovery from the contextual documents. This multimedia-based Question Answering System using agents (MQASA) in eLearning paradigm help the student to find answering more relevant and accurate as shown in Fig. 3. The proposed solution MQASA will use the following steps:

- The student enters the query related to the subject, the query may have related to text or image and video as shown in Eq. (1)
- After identification the query, text based or image based,
- **Agent A1** tokenized the student's query and lexical analysis is carried out using corpus to validate the query
- Question type is identified for answering
- Parallel to query identification, GPS coordinates are collected
- In Text query keywords are extracted
- Headwords are identified for the keywords
- Then text processing and NLP tools are used to clear understanding of the query syntax and semantics
- Knowledge repository is check either answer is already existing
- Now Answer is being processed by using

Table 1 Data and Text Mining Techniques with Algorithms used for the Structured Data

Tasks	Functions	Properties	Cases	Algorithms and Approaches	Type of Techniques
Class Description	Summarization and discrimination	Count, sum, Average	European versus Asian sale of a company	Identification of important factors which dominates the classes	Predictive
Association	Association and Correlations	Rules & attribute condition, X = > Y	Transaction data analysis	Mining-correlation, Constraint-based Mining	Description
Classification	Decision tree	Set of labels is known	Classification of diseases	Machine learning, neural network	
Prediction	Predict some value	Statistical Analysis	Employee salary distribution prediction based on similar bases	Regression analysis, Linear model analysis, Genetic algorithm	Predictive
Clustering	Collection of data objects	Distance function	Cluster the houses on the basis of Area, floor, design	Scalable Clustering, Multidimensional Modelling	Description
Time Series Analysis	Large set of time series data	Mining Sequential patterns, Trends	Stock History based trends		Descriptive

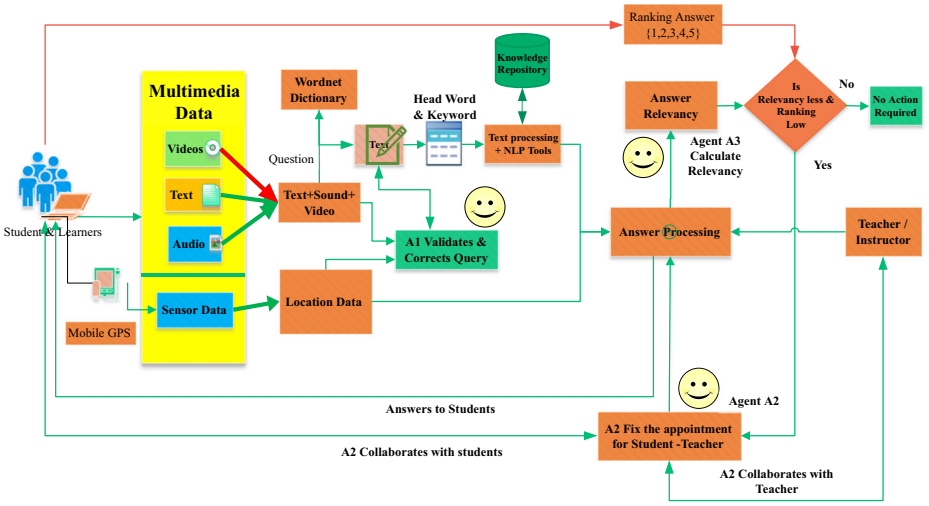

Fig. 3 Multimedia based Question Answering System using Agents in eLearning

From the web document
PDF file or other text documents

- Processed answer is delivered to student
- Student ranked the auto-generated answer
- Answer relevance is calculated by the **agent A3** for the further processing
- Now satisfaction level of the student from the given response is measured

If response is satisfactory then no action
Else Agent A2 collaborate with teacher and student

- Agent collects the mobile GPS sensor to find the coordinate of the student
- If agent found a teacher's free slot and student on his campus or at calm place

Then fix the appointment with immediate effect
Else fix some other slot after communication with student and teacher for multimedia session using synchronous tool

- Thus, **agent A2** provides the Multimedia content-based collaboration between student and teacher for improved learning

In text mining for question answering different types of data that may include are ".pdf", ".docx", ".xlsx" and ".ppt" etc. files. In the text mining, the document may be classified on the basis of their types and contents. Web mining is a subtype of text mining makes the clusters of the Web pages that may be related contents. This organization of the web pages as clusters that visited by the different users may organize pages according to their visited history. It will use the machine learning techniques that help for automatically categorization and classification of the web pages. While in the graph, mining will deal the graphical data and find the different patterns and trends.

Mathematical representation of the Learning Model using Multimedia data as intermediate source to gain results, where.

W	Set of all words
V	Set of all videos
A	Set of all audios
l	Set of all images
i	Selected images element
a	Selected audios element
t	Specific time per instance
v_t	Video at a specific time

Multimedia data comes in different formats like video, images, audio and audio, which can be seen in mathematical form as follows:

The probability of words w under the video v at time t, text words are extracted from the video measured in Eq. (1)

$$P\left(\frac{w}{v_t}\right) = \frac{P\left(\frac{w}{t}\right)P\left(\frac{w}{i}\right)}{P\left(\frac{w}{v}\right)} \tag{1}$$

Probability of audio a under the video v at time t, the audio is extracted and onwards used for the understanding of the system as presented by Eq. (2).

$$P\left(\frac{a}{v_t}\right) = \frac{P\left(\frac{a}{t}\right)P\left(\frac{a}{i}\right)}{P\left(\frac{a}{v}\right)} \tag{2}$$

The probability of images i under the video v at time t, images are extracted and images frame are processed for the question as in Eq. (3).

$$P\left(\frac{w}{v_t}\right) = \frac{P\left(\frac{i}{t}\right)}{P\left(\frac{i}{v}\right)} \tag{3}$$

Complete video at time t can be computed as by using Eq. (1), (2) and (3)

$$v_t = P\left(\frac{w}{v_t}\right) + P\left(\frac{a}{v_t}\right) + P\left(\frac{i}{v_t}\right) \tag{4}$$

Eq. (4) represent the text, audio, and video extracted data to the ensemble for the mutual understanding of the syntax of the query.

Multimedia data, let's say B can be calculated as by using Eq. (1), (2), (3) and (4).

$$\begin{aligned} B(t) &= \lambda\ v_t + \beta\, i_t + \gamma\ w_t + \mu\ a_t \\ \therefore\quad (\lambda,\ \mu,\ \gamma,\ \mu) &\in \{0,1\} \end{aligned} \tag{5}$$

These factors are used to know whether video, images, audio and words exist at instance t or not separately through Eq. (5).

$$T(B(t)) = \{A_t + I_t\} \tag{6}$$

Eq. (6) shows that transformed input data into either Audio and Images which becomes a knowledge base for multimedia big data at instance t shown in Eq. (7)

$$KN_B = T(B(t)) \tag{7}$$

Complete knowledge base *KN*.

$$KN = \{A + I\}$$

Classified knowledgebase subtracted from complete knowledge base resulting in domain level knowledge base by Eq. (8)

$$KN_{\mathrm{D}} = KN - KN_C \tag{8}$$

A mapping function $M(KN_B)$ to check where KN_B exist in the domain

$$\lim_{i \to n} M(KN_B) = (KN_{\mathrm{D}})_i - KN_B$$

$$\because n \in \mathbb{N}$$

n is total domain identified.

$$M(KN_B) = x \begin{cases} 0 & \text{undefined} \\ x < 0 & \text{belongs } \textbf{to} \text{ domaini} \end{cases}$$

This function values can be used to show where finding are going in the right direction or not if zero returned. Whereas, greater the value of x greater the correlation is domain correspondence when it comes to eLearning.

4 Results and discussions

The auto answered text data is gathered that analyze the trends in term of frequency pattern identification. Word cloud works on the term frequency and gives the most prominent that appears in the sources.

Algorithm 1. Word cloud construction using a list of keywords

Input: Comma Separated Values data file (*.CSV)
Output: Word Cloud for student query-answer Data
Start
    Preprocessing {
        Delete punctuation marks from the text
        Delete numbers
        Conversion to lowercase
        Delete "stop words"
        Delete common word endings* (e.g., "ing", "es")
        Strip whitespace
    } Preprocessing
    Word Clouds {
        Perform Hierarchal Clustering by using term similarity and word frequencies
    } Word Clouds
End

Word cloud is present graphically frequency and occurrence of the words in single file as shown in Fig. 4.

It may also be used to find the trends in question answer about which specific concept question are asked. In the given word cloud represent the trends about the most of the queries are used the word assignments means student most of the time face the difficulties while preparing a solution of their assignments.

a) **Answering Delay Measurement**

Delay in question answering faced by the students in eLearning paradigm effects their learning process very badly. Fig 5 shows the delay measured for the student. The color of the bubbles represents the sum of the number of the records. While, the size of the bubble denoted the maximum, count of the delays occurred while student queries are handled.

The total number of delay records in answering the student replies are counted as 2216. Total delay measured in answering the student queries are being 894,918.0 h with average delay is calculated as 403.8 per record faced by the students. Minimum delay is measured as 13.0 h per question and maximum delay measured is 506 h regarding the single student.

b) **Correlation Representation**

Correlation denotes the general class of statistical association comprising dependency, although in collective treatment it most often discusses that two variables at the extent have a linear relationship. Fig 6 represents the correlation among the terms represented by the instructor answers in response to a student question. There 3434 records data are after preprocessing is analyzed. The total term is added as an appendix Table 4 in the paper.

c) **Relevancy Calculation**

To find the relevancy of the answer delivered to the student, the following step are performed:

Fig. 4 Word Cloud for the terms used in Answers dataset to the Student Questions

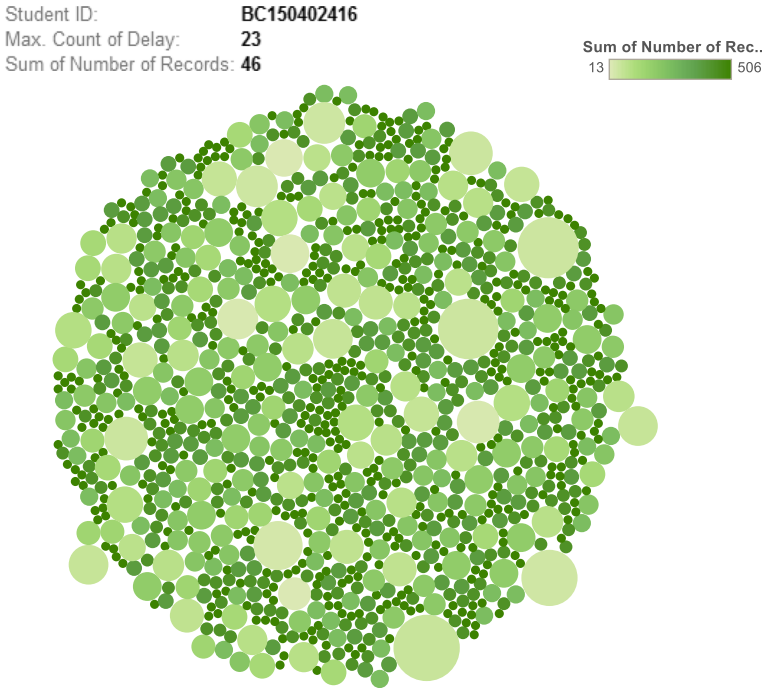

Fig. 5 Sum of maximum records vs. sum of maximum delay

Step 1: Term Frequency (TF)

Term Frequency measures the number of times a term (word) occurs in a document. Given below are the terms and their frequency on each of the document.

$$\mathrm{TF}(\mathrm{w}i, \mathrm{d}i) = 3 \tag{9}$$

Eq. (9) used for the calculation of the Term Frequency.

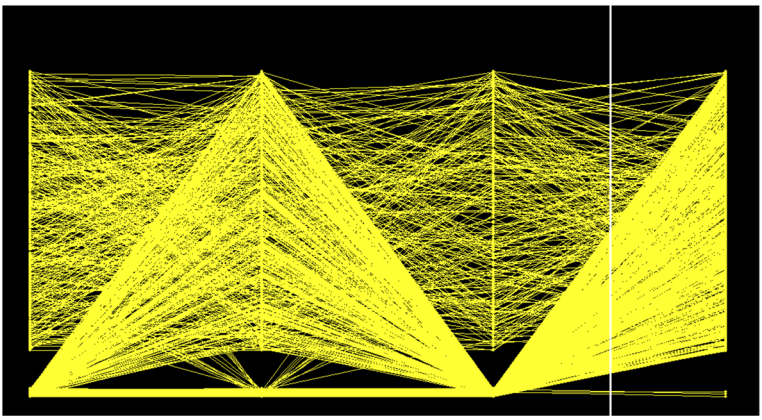

Fig. 6 Student's Question Terms Correlation with Overall Dataset Used for this Research

Step 2: Inverse Document Frequency (IDF)

The main purpose of doing a search is to find out relevant documents matching the query. In the first step, all terms are considered equally important. In fact, certain terms that occur too frequently have little power in determining the relevance.

$$\text{idf}\ (\text{W}i, \text{D}i) = \log \frac{N}{|\{d \in D :\ \ t \in d\}|} \tag{10}$$

Eq. (10) used for the calculation of the Inverse Document Frequency.

So, a score of keywords is calculated as using Term frequency–Inverse document frequency**.**

Then tf-idf is calculated as by eq. (11)

$$\text{Wi} = (\text{TFi}) \times (\text{IDFi}) = \text{tf}_\text{i}\ \times \log \frac{ND}{df_{\ i}} \tag{11}$$

Step 3: The location Feature

P. Baxendale introduced a feature based on “Sentence Position”. Although his work was almost manual but later on this measure used widely in sentence scoring, he proposed that leading sentences of an article are important. A model which we are using given below, where N is a total number of sentences as in eq. (12). The used model is:

(Where: 1 < i < N, and *Score (Si)* = (0, 1])

$$\text{Score}\ (Si) = 1 - \left[(\text{i}-1)\ \Big/\ \text{N}\right] \tag{12}$$

Step 4: The aggregation similarity Feature

Kim et al. defined aggregate similarity as, "the score of a sentence is as the sum of similarities with other all sentence vectors in document vector space model". It is given by eq. (12) & (13)

$$\text{Sim}\ (\text{Si}, \text{Sj}) = \sum_{k=1}^{n} \text{Wik.Wjk} \tag{13}$$

$$\text{Score}\ (\text{Si}) = \sum_{j=1, j \neq i}^{n} (Sim(Si, Sj)) \tag{14}$$

Where **Wik** is defined as the binary weight of **kth** word in **ith** sentence and **Wjk** is defined as the binary weight of **kth** word in **jth** sentence. The cosine measure between two sentences $\text{Si} = [\text{W}_{\text{i1}}, \text{W}_{\text{i2}}, \ldots \text{W}_{\text{im}}]$ and $\text{Sj} = [\text{W}_{\text{j1}}, \text{W}_{\text{j2}}, \ldots. \text{W}_{\text{jm}}]$. Standard Cosine similarity measure gives by following a formula which is used in our implementation is below.

$$\text{Sim}\ (\text{Si}, \text{Sj}) = \frac{\sum_{k=1}^{m}\ Wik.Wjk}{\sqrt{\sum_{k=1}^{m}\ W_{ik}^2 \cdot \sum_{k=1}^{m}\ W_{jk}^2}} \quad i, j = 1 \quad to\ n \tag{15}$$

Eq. (15) used for the calculation of the cosine similarity, which further used for the measurement of aggregation similarity.

Step 5: Relevancy Score of Each keyword

Final relevancy score of the keyword is calculated by the following formula as shown in eq. (16).

$$\text{Word Relevancy (W)} = [\text{L} + \text{S}i + \text{F} + \text{W}i] \tag{16}$$

Where

L:	Location score
Si:	Aggregation similarity feature using cosine similarity
F Score:	Frequency Score
Wi Score:	Term frequency and Inverse document frequency

Question Answer overall relevancy, that is retrieved in response to student query calculated as Question Answer Relevancy (QA***r***) is calculated as in eq. (17)

$$\text{QA}r \ \sum_{i=1}^{n}(\text{W}i) \tag{17}$$

Where "***i*** = 1 … n" and "QAr" represents the Question Answer relevancy.

The above eq. (16) provides the words relevancy, whereas the eq. (17) gives the question answer relevancy in the automatically extracted answer using the multimedia based question answering system using agents for the students. These relevancies use the effectiveness of the answer in eLearning paradigm. If the measured score is high, then the answer is more relevant. Later on, this relevancy measure used in the decision-making process of synchronous student-teacher interaction in eLearning.

Let's a simple query "what is the role of operating system?" run on MQASA system and take a subset of the keywords and calculate the relevance for the decision-making at a later stage to fix appointments of the student-teacher interaction in synchronous communications. Table 2 denoted the keywords relevancy on small subset keywords of the answer delivered to the student that is calculated by using the eq. (11).

In the Table 2 keywords relevancy is measured by using the different formulae and algorithm. The answer extracted from the web sources and documents. These extracted documents are used to further extracting the relevance text to compose the answer to the student question. The text is extracted along with the relevance values of the terms. The

Table 2 Keywords Relevancy in answers response to student question used to calculate the answer relevancy (Subset of Answer)

Text	Type	Count	Relevance
Application software	Field Terminology	13	0.7847
Computer programmer	Field Terminology	3	0.7722
Operating system	Field Terminology	14	0.7134
Programming language	Field Terminology	9	0.6311
Source code	Field Terminology	7	0.5228
CPU	Technology	3	0.4236
Analytical engine	Field Terminology	4	0.4183
Software development	Field Terminology	2	0.3958
System software	Field Terminology	4	0.3832
Programmer	Job Title	4	0.3701

answers are extracted more one from the collection of the documents. These extracted answers for each question are ranked according to the relevance of the terms containing. The most relevance answer is delivered to students in response to their question. The students will after be receiving the answer will provide the feedback.

Now agent A2 collects the feedback from the students. This feedback along with question relevancy used to measure the need for multimedia-based communications. If the student feedback is satisfactory then the agent A2 will fix major role-plays in the next step towards appointment. After taking the decision of appointment will be fixed. Agent A2 collects the coordinates through smartphone GPS sensor as shown in Table 3. These coordinates are helpful to detecting the location of the student. Once the student location is identified then agent A2 decides for either immediate appointment is possible in case teacher has a free slot. Otherwise, appointment deferred to some appropriate time.

Appropriate time will have sought out by a collaboration of the student and agent A2. While Agent A2 also communicate to the teacher for the available free slots. Therefore, the student teacher synchronous interaction is possible for a better solution of the student problems. Now Google Map is used to find out the locations of students. User smartphones are used to collect their Global Positioning System(GPS) coordinates. Google Maps API has used the location into coordinates like latitude and longitude dynamically, and these coordinates are used to place markers on the map as shown in Fig. 7. Multiple markers show locations of students, whether they are in the campus or somewhere else while using the framework which is based on multimedia in eLearning.

Agent A3 calculates the relevance of the answer and wait for the feedback from the students. There is some possible scenario exists as follows:

Case 1 After the answer relevancy is calculated then the agent A3 waits for the student feedback. Student ranked the answer after reading it. The answer contents delivered to the students contain the material regarding the question. If the student feels, satisfaction ranked

Table 3 A subset of students collected data through smartphone GPS

Student #	Latitude	Longitude	Location
1	33.63978484	73.07521115	Campus
2	33.63920424	73.07149337	Swedish Institute of Technology
3	33.63977484	73.07529315	Campus
4	33.63976484	73.07524415	Campus
5	33.63804305	73.07392538	Lasania
6	33.63893521	73.07305366	Chaman Ice Cream
7	33.63975484	73.07528515	Campus
8	33.63974484	73.07526615	Campus
9	33.63920424	73.07139337	Swedish Institute of Technology
10	33.63972484	73.07524815	Campus
11	33.63977484	73.07530215	Campus
12	33.63894521	73.07315366	Chaman Ice Cream
13	33.64044581	73.0749473	Office, Workspace
14	33.63973484	73.07530715	Campus
15	33.63804305	73.07382538	Lasania
16	33.63971484	73.07513715	Campus
17	33.63970484	73.07512615	Campus

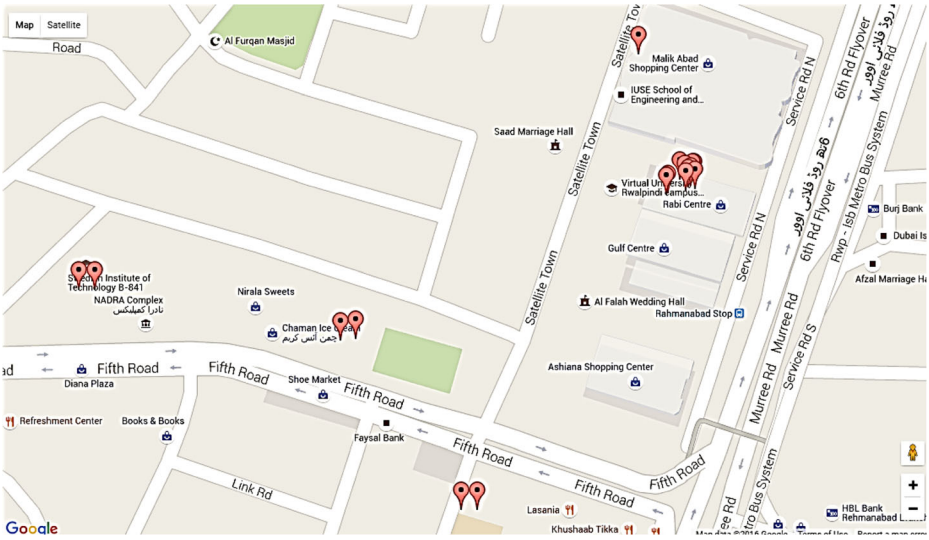

Fig. 7 Representation of the of Student(subset) data clusters location on the Google Map

good and relevancy of the answer is also measured as higher than the threshold, then Agent A3 takes no action. As agent A2, received no input from the agent A3, hence the student-learning process is satisfactory in subject learning.

Case 2 If the measured relevancy is less than threshold, and the contents are not related to the student question. Then answer is not relevant the question extracted keywords and headword. The student has no knowledge about the concept and may feel satisfactory. As the content delivered are understandable and useful then student ranked the answer very good. In this case the agent 3 will remain motionless. The student learning is upward and no need to fix the appointment.

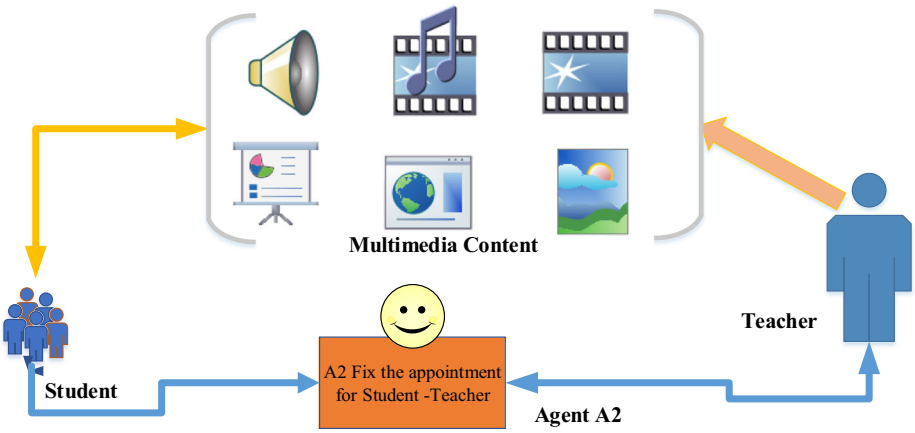

Fig. 8 Student Appointments and Multimedia Content Delivery Model

Case 3 In the eLearning environment the student is answered by the system developed during the research work. If the student below the mark ranks the auto-replied answer by the MQASA and answer relevancy is measured less than the threshold, then Agent A3 sends the result toward agent A2, Agent A2 will collaborate the teacher and student. Agent A2 checks the location of the student by the help of the mobile GPS. The value of the coordinates accessed by the Agent A2 is shown in Fig. 8. In case if the student is at home are in office, then A2 will check the teacher availability for the appointment. If the teacher has a free slot, then agent A2 will fix the appointment with immediate effect and inform the student after taking the consent of the teacher. Now, the student can interact with the teacher by using the synchronous communication media tools like Skype, Team weaver, Camtasia etc. for an audio video call or presentation. Teacher delivers the multimedia contents to answer the student query at a satisfactory level. This will boost the learning process of the student and learn curve is enhanced. If the student is located by the agent A2 in the market or in some place where silence and comfort level is very low or student in a noisy environment. Then A2 will take action after collaboration with teacher and will fix the deferred appointment for the student-teacher multimedia-based interaction.

This research work enhances the student learning and analysis by the multimedia representation and content delivery. This agent-based architecture will provide the better student-teacher interaction to boost the learning process of the student.

5 Conclusion

The finding of this research is that advanced tool and technologies are used more effectively to facilitate the student. Question answering in the eLearnign paradigm plays a key role to enhance the student learning. If the answering, faces delay student learning process in affected very badly. The eLearning solution can be developed with the current technologies that lead to the Multimedia data. The analytics presents the learning behavior, outcomes, and the learning targets. The analysis of the relationship between multimedia data used for the academia and student-teacher interactions for educational performance evaluation and enhancements is significant. The proposed model is extracting the data from the different sources and then integrates it for the learning purposes. Irrespective of the system usability, this research is a systematic approach to providing the study of the associations and relations, which applies to all kinds of learning environments especially in eLearning paradigm. The limitation of this research are agent communication delay, and understanding the complete semantics of the context by the agent. The mathematical explanation is used to capture the learning scenarios and data elements for the student learning and skills enhancements. In future semantic role labeling and little changes in the user interface with prototype can be evaluated. It is proposed to clarify the issue of the sufficient and necessary condition, apply given framework using different combinations of systems, and eliminate the restriction.

Acknowledgements This paper was supported by Wonkwang University in 2017.

Appendix

Table 4 represents the keywords used for the answering the student questions in gathered real-time data that is 3434 records

1	able	2	access	3	According
4	accordingly	5	account	6	Achieve
7	active	8	actually	9	*Ada*
10	add	11	address	12	Adobe
13	advised	14	alaikum	15	Algorithm
16	*ali*	17	*alikum*	18	*Allah*
19	allowed	20	almost	21	Already
22	also	23	altafvuedupk	24	Always
25	announced	26	announcement	27	Announcements
28	another	29	ans	30	Answer
31	anymore	32	aoa	33	Appear
34	application	35	applications	36	Appreciate
37	appreciated	38	appreciation	39	Approximately
40	area	41	array	42	*Asalam*
43	ask	44	asked	45	Assalam
46	assalamoalaikum	47	assess	48	Assigment
49	assignment	50	assignments	51	Attempt
52	attend	53	attending	54	Attention
55	attribute	56	available	57	Back
58	based	59	basic	60	Basis
61	become	62	best	63	Better
64	big	65	binary	66	Bit
67	body	68	book	69	Books
70	browser	71	bus	72	Button
73	called	74	can	75	Carry
76	case	77	change	78	Check
79	choose	80	clear	81	Click
82	closed	83	code	84	Coding
85	comments	86	complete	87	Computer
88	computers	89	computing	90	Concept
91	concepts	92	confused	93	Confusion
94	congratulations	95	connect	96	Consist
97	contact	98	contain	99	Contains
100	content	101	contents	102	Convert
103	core	104	correct	105	Course
106	courses	107	covered	108	Cpu
109	create	110	creation	111	Csvuedupk
112	current	113	daily	114	Data
115	date	116	day	117	Days
118	decimal	119	declared	120	Degree
121	descriptive	122	design	123	Designed
124	detail	125	details	126	Develop
127	developing	128	development	129	Device
130	devices	131	difference	132	Different
133	digital	134	discuss	135	Discussed
136	document	137	domain	138	Don
139	done	140	dont	141	Download
142	due	143	easily	144	Easy
145	effort	146	electronic	147	Email
148	end	149	engine	150	Enough
151	enter	152	error	153	Etc
154	even	155	every	156	Everything
157	exam	158	example	159	Exams
160	excel	161	explain	162	Extension

Table 4 (continued)

163	face	164	faster	165	Feel
166	field	167	file	168	Files
169	final	170	find	171	Fine
172	first	173	firstcome	174	Firstserve
175	follow	176	following	177	Form
178	format	179	formula	180	Found
181	free	182	full	183	Function
184	functions	185	furthermore	186	Future
187	gdb	188	get	189	Give
190	given	191	goals	192	Going
193	good	194	graded	195	Great
196	guidance	197	guide	198	Hafiz
199	hai	200	handouts	201	Hard
202	hardware	203	head	204	Heat
205	held	206	hello	207	Help
208	helpful	209	high	210	Highly
211	home	212	homesteader	213	Hope
214	however	215	html	216	http
217	httpmembersgeocitiesws	218	httpwwwgeocitiesws	219	Human
220	icon	221	important	222	Improve
223	included	224	inform	225	Information
226	informative	227	input	228	Instead
229	instruction	230	instructions	231	Instructor
232	interesting	233	interface	234	Internet
235	introduction	236	issue	237	Issues
238	item	239	java	240	Javascript
241	job	242	join	243	Joined
244	joining	245	just	246	Keep
247	kia	248	kind	249	Kindly
250	know	251	knowledge	252	Language
253	large	254	last	255	Latest
256	learn	257	least	258	Lecture
259	lectures	260	lesson	261	Let
262	level	263	life	264	Like
265	link	266	links	267	List
268	listen	269	lms	270	Logic
271	login	272	lot	273	Luck
274	machine	275	made	276	Mail
277	main	278	make	279	Making
280	manage	281	manager	282	Mandatory
283	many	284	mark	285	Marks
286	markup	287	maximum	288	May
289	mcqs	290	mdb	291	Mean
292	means	293	mein	294	Member
295	memory	296	mention	297	Mentioned
298	mentioning	299	message	300	Method
301	microprocessor	302	microprocessors	303	Mid
304	midterm	305	missed	306	Moreover
307	much	308	muhammad	309	Multiple
310	must	311	name	312	Nasar
313	necessary	314	need	315	Needs
316	network	317	new	318	Next
319	nhi	320	nice	321	Nongraded
322	note	323	notepad	324	Now
325	number	326	numbers	327	Object
328	one	329	online	330	Open
331	operating	332	operations	333	Option
334	order	335	output	336	Overall
337	page	338	pages	339	Paper

Table 4 (continued)

340	parallel	341	part	342	Participate
343	participation	344	password	345	People
346	per	347	percentage	348	Perform
349	performance	350	person	351	Personal
352	please	353	plz	354	Point
355	possible	356	post	357	Power
358	powerful	359	practice	360	Pre
361	preparation	362	prepare	363	Price
364	problem	365	process	366	Processing
367	processor	368	processors	369	Profit
370	program	371	programming	372	Programs
373	proper	374	properly	375	Provide
376	provided	377	purpose	378	Quantum
379	queries	380	query	381	Question
382	questions	383	quiz	384	Quizzes
385	ram	386	reached	387	Read
388	really	389	reason	390	Recommended
391	reference	392	regard	393	Regarding
394	regards	395	regular	396	Regularly
397	related	398	relevant	399	Remaining
400	reply	401	request	402	Required
403	research	404	respected	405	Result
406	right	407	roll	408	Rom
409	run	410	said	411	Salam
412	sania	413	save	414	Say
415	schedule	416	science	417	Screen
418	script	419	section	420	See
421	select	422	selling	423	Send
424	sent	425	server	426	Session
427	sessions	428	set	429	Short
430	show	431	sign	432	Simple
433	simply	434	since	435	Single
436	site	437	size	438	Skills
439	slot	440	slots	441	Small
442	software	443	solution	444	Solve
445	soon	446	specific	447	Specified
448	speed	449	stands	450	Start
451	started	452	starting	453	Status
454	steps	455	still	456	Storage
457	student	458	students	459	Studies
460	study	461	style	462	Subject
463	submit	464	submitted	465	Successful
466	suggestion	467	super	468	Support
469	sure	470	syllabus	471	System
472	systems	473	table	474	Tag
475	tags	476	take	477	Task
478	tasks	479	tdb	480	Teacher
481	teaching	482	technology	483	Tell
484	ten	485	term	486	Text
487	thank	488	thanks	489	Therefore
490	thing	491	things	492	Think
493	three	494	tick	495	Till
496	time	497	today	498	Tomorrow
499	top	500	topic	501	Topics
502	total	503	try	504	Two
505	type	506	types	507	Typetext
508	unable	509	understand	510	Understanding
511	unit	512	university	513	Upcoming
514	upload	515	uploaded	516	Uploading

Table 4 (continued)

517	uploadsubmit	518	upon	519	url
520	use	521	used	522	Useful
523	user	524	users	525	Using
526	usman	527	value	528	Values
529	var	530	video	531	View
532	virtual	533	visible	534	Visit
535	visiting	536	vulms	537	Want
538	watch	539	way	540	Web
541	webpage	542	website	543	Week
544	welcome	545	well	546	Whereas
547	wide	548	will	549	Wish
550	without	551	word	552	Words
553	work	554	working	555	World
556	worried	557	worry	558	Write
559	writing	560	written	561	Years
562	yes				

These all words are part of the dataset and very important for the analysis perspective collectively and individually *Ada* is a structured, statically typed, imperative, wide-spectrumand object-oriented high-level computer programming language, extended from Pascal and other languages. It has built-in language support for design-by-contract, extremely strong typing, explicit concurrency, offering tasks, synchronous message passing, protected objects, and non-determinism. *Ada* improves code safety and maintainability by using the compiler to find errors in favor of runtime errors. *Ada* is an international standard; the current version known as *Ada* 2012 is defined by ISO/IEC 8652:2012. *Ali* is the name of the student wants to ask the question from the teacher on Moderated Discussion Board. *Alikum* in the part of greeting from the cultural context. Someone ask a question about the *Alikum*. *Allah* is the creator of the universe and may be asked about by the student in question regarding HIS vital powers and about discoveries. *Asalam* is the part of the dataset as for going to ask the question, another option is the use for the greeting as well. Someone ask the question about the *Asalam*. Moreover, in single sentence "*Ali*" is the student who start with greeting "*Asalam- Alikum*" to his virtual teacher and wants to ask a question about the "*Ada*" Language with ending by the mighty creator "*Allah*"

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