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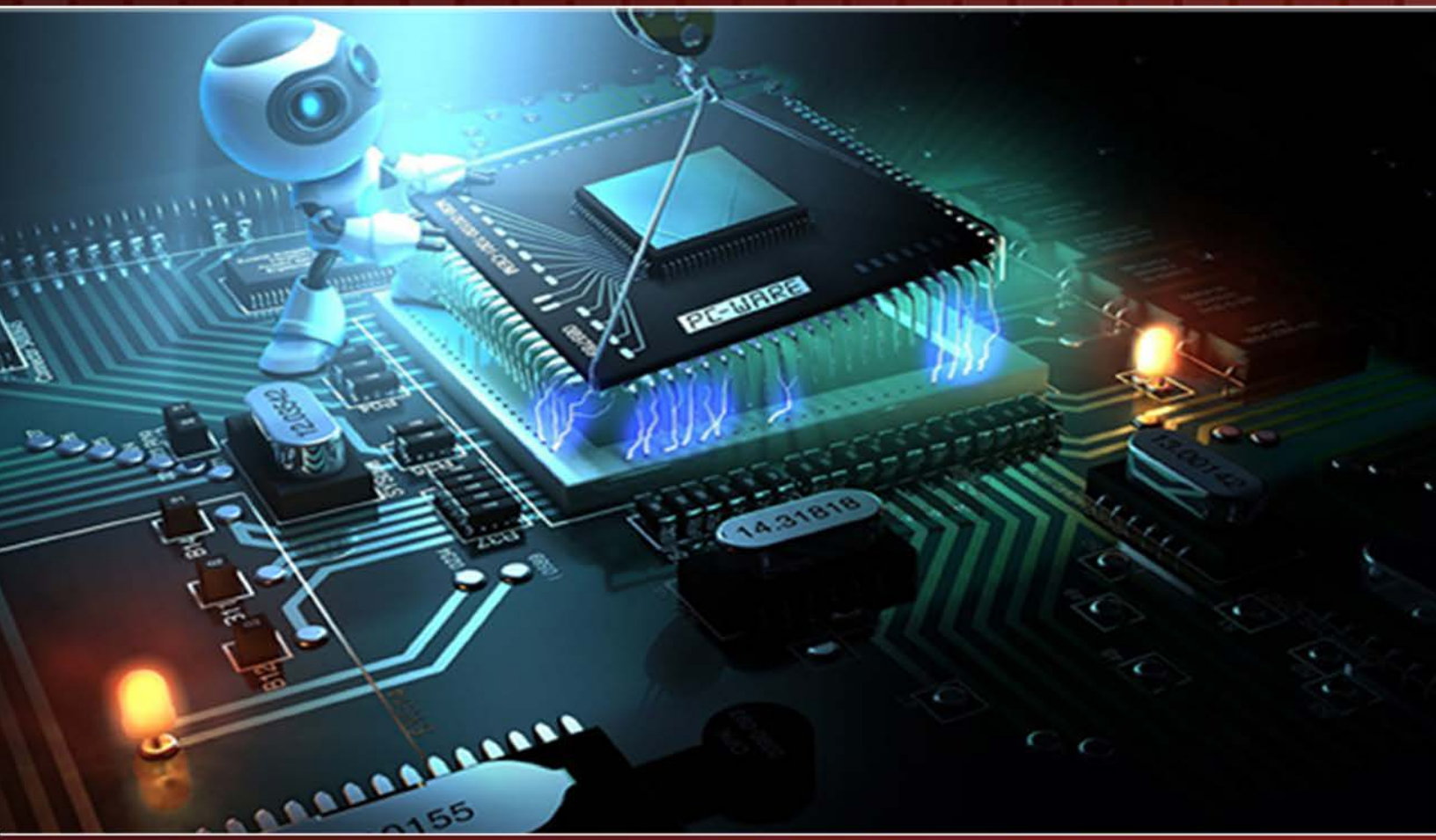

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Development of SLA Monitoring Tools Based on Proposed DMI in Cloud Computing

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ABSTRACT

Service level agreement (SLA) is a contract between service provider and user about the quality of service (QoS) in cloud computing. The cost value and benefit value of SLA monitoring systems is a concerned issue in cloud computing. The trustable SLA monitoring model is important to assess SLA validation in cloud computing. The optimization of monitoring interval is another objective of study to economize SLA monitoring system. Therefore in this paper the SLA monitoring tools is developed to evaluate the proposed dynamic interval in actual test bed of cloud computing. The experiment design described in this paper presents the cloud configuration and environmental setup for test bed experiment.

Keywords: Service Level Agreement; Dynamic Monitoring Interval; Cloud Computing; Cost; Monitoring Tools; Quality of Service.

1 Introduction

Service level agreement (SLA) is a contract between service provider and user upon quality of service (QoS) in cloud computing [1]. SLA contains the agreed attributes and the value of service level objectives (SLO). Service provider should deliver services based on agreed quality in SLA. If quality value of running service exceeds the agreed SLO, service provider must pay penalty for this SLA violation. The SLA monitoring tools is unavoidable to evaluate agreed SLAs at the run time and detect any probable SLA violations [2]. Both service provider and consumer need to monitor the QoS to be sure about SLA validity. The cost value and benefit value of SLA monitoring systems are a concerned issue in cloud computing [3]. The SLA monitoring systems need resources consumption consisting CPU, Memory, and Storage for execution. The amount of consumed resources by monitoring system is the cost of SLA evaluation. On the other hand, SLA monitoring systems make benefits by detecting the SLA violations because service provider afterward can adapt the infrastructure to prevent more numbers of SLA violations and avoid penalty cost. This study proposes the SLA evaluation model to increase the adaptability of SLA monitoring systems and subsequently detect the most probable SLA violations with a reasonable overhead cost. The costs and benefits of SLA monitoring system is the main focus of this study. Interval value of SLA monitoring system is the central concentrated issue in this area because it has a high impact on cost value and benefit value of monitoring system. An existing cloud service is executed in developed test bed and the predefined SLA attributes are evaluated by developed monitoring tools.

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2 The Proposed Adaptive SLA Evaluation Model

The trustable SLA monitoring model is proposed to assess SLA validation in cloud computing [4]. The optimization of monitoring interval is another objective of study to economize SLA monitoring system. The SLA monitoring tools is developed to evaluate the proposed dynamic interval in actual test bed of cloud computing. The proposed trustable SLA monitoring model is presented Figure 1. Proposed model contains three actors including Service Provider (SP), Trusted Party (TP), and User. The negotiation process between SP and user is done by TP [5] cooperation before SLA monitoring process. The agreed SLA, then, is recorded in TP database for run time monitoring activities. The monitoring engine is installed in SP center by TP to collect the raw data for assessing the agreed SLA attributes. Although the monitoring engine is located in SP center but SP does not have permission to access or manipulate the collected data by monitoring engine. Monitoring engine, indeed, is a part of trusted party but located in SP center for data collection purposes.

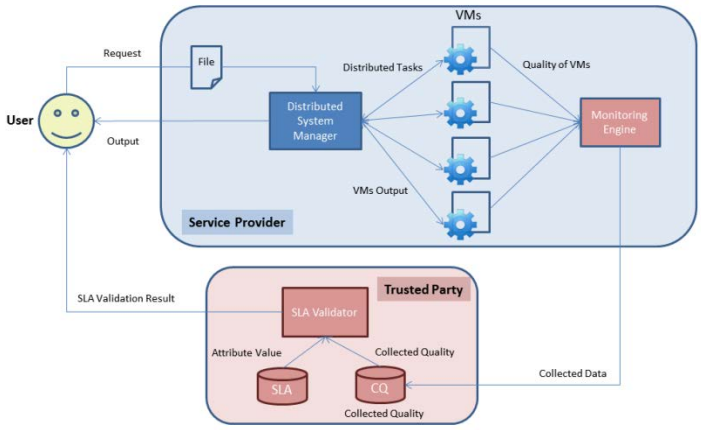

Figure 1: Proposed adaptive SLA evaluation model

The Distributed System Manager (DSM) is located in SP center to manage the task scheduling and process. DSM gets the user request which contains the name of agreed service and any probable input data and files. DSM checks the request validity and employs the needed VMs based on agreed SLA. The task is then distributed among VMs to execute the process. Each VM responds the output of the process to DSM. Finally, DSM combines the received results from VMs and sends the output to the user. Monitoring engine collects the value of SLA attributes from VMs when the tasks are processing. The collected data send to the TP center for SLA evaluation. SLA validator maps the collected data to the SLA attributes and then compares the actual quality to the agreed SLO. The SLA validation result is sent to the user to be aware about SLA validity and SLA violations. **Error! Reference source not found.** presents the activity diagram of service running and SLA monitoring. The tasks are distributed among VMs after receiving the user request and input file. The task processing and QoS collecting are done at the same time. The respond results from VMs are combined by DSM and the collected data about QoS are sent to the TP at the same time. Finally, user gets the output of service from SP and also the SLA validation report from TP.

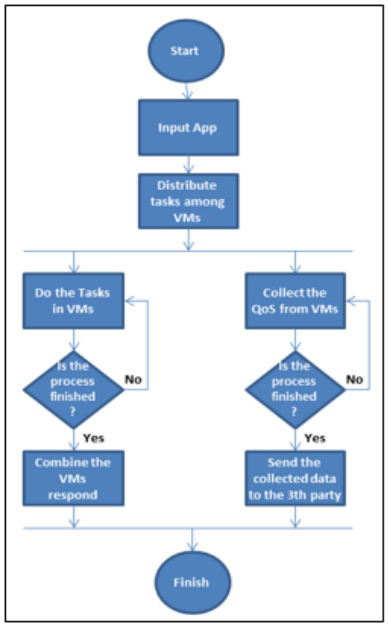

Figure 2: Activity-diagram of SLA

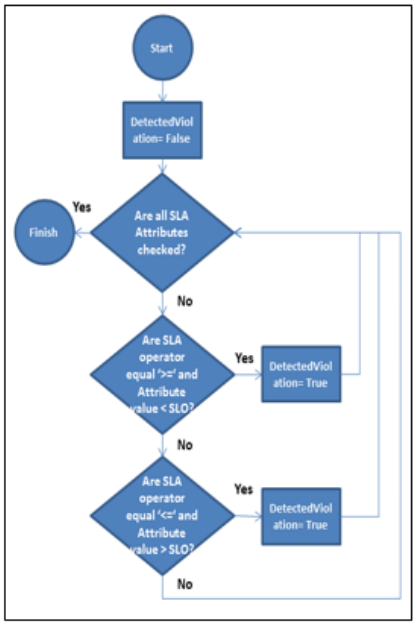

Figure 3: SLA Evaluation Process

Figure 3 shows the SLA evaluation process which is done by TP. In the first step, process assumes that the SLA is not violated as a default. The collected data from VMs are mapped from low-level metrics to high-level attribute based on defined formula in SLA. The measured value of attribute then compares with agreed SLO based on defined operator for that attribute in SLA. If the attribute value exceeds the agreed SLO, the SLA is violated. This process is repeated for all stated attributes in SLA.

3 SLA Monitoring Tools Based on Proposed DMI

The dynamic monitoring interval (DMI) is proposed to economize the SLA monitoring system. DMI aims to reduce the overhead of monitoring system when the agreed service is working normally. Moreover, The SLA violations should be detected when the quality of agreed service exceed the defined quality in SLA. The number of missed violation detection should be minimized. The following DMI formula is proposed to adapt the interval value based on the cost and benefit values of monitoring system. Monitoring Cost (MC) is the sum of needed Storage, Memory and Processor resources which are consumed by monitoring system in execution time. The cost of each resource measures by multiplying the amount of resource usage in the cost unit of the resource. The main objective of SLA monitoring system is the SLA violation detection to prevent further violation by suitable reactions. It reduces the total penalty cost which should be pained to the user. The Violation Detection Benefit (VDB) is the benefit of monitoring system which it is measured by multiplying the penalty cost in the number of detected violations.

$$Monitoring\ Interval\ (I) = \begin{cases} \frac{I}{2}, & MC < VDB \\ I, & MC = VDB \\ I + \frac{I}{4}, & MC > VDB \end{cases}$$

$$Monitoring\ Cost\ (MC) = \sum_{i=0}^{n} (S * SCU + M * MCU + P * PCU)$$

$$Violation\ Detection\ Benefit\ (VDB) = \mathrm{PC} * \sum_{i=0}^{n} DV$$

S: Storage usage
SCU: Storage cost unit
M: Memory usage
MCU: Memory cost unit
P: Processor usage
PCU: Processor cost unit
PC: Penalty cost
DV: Detected Violation
n: number of monitoring iterations

The monitoring interval becomes the half of interval value when the VDB is larger than MC. The agreed service is running without or with a few violations in this period so the monitoring interval is deducted to reduce the monitoring cost. On the other hand, the quarter of monitoring interval is added to the interval value when the MC is larger than VDB. In this period, significant number of SLA violations is detected and the monitoring system should run faster to increase the profit of monitoring system and detect any probable SLA violations. The interval value is not changed if the MC and VDB are equal. A SLA monitoring tools is developed based on proposed DMI to monitor the agreed SLAs. Figure 4 shows the developed SLA monitoring tools at the run time. It is monitoring the processor, memory and storage usage value of employed VMs. Each resource usage is presented in forms of total consumption and VMs consumption. Detected SLA violations and the violated attribute value are shown in a column. The cost and benefit of monitoring tools are also measured at the run time and they are used in monitoring interval adaptation process. The changes of interval value are presented in Interval TextBox.

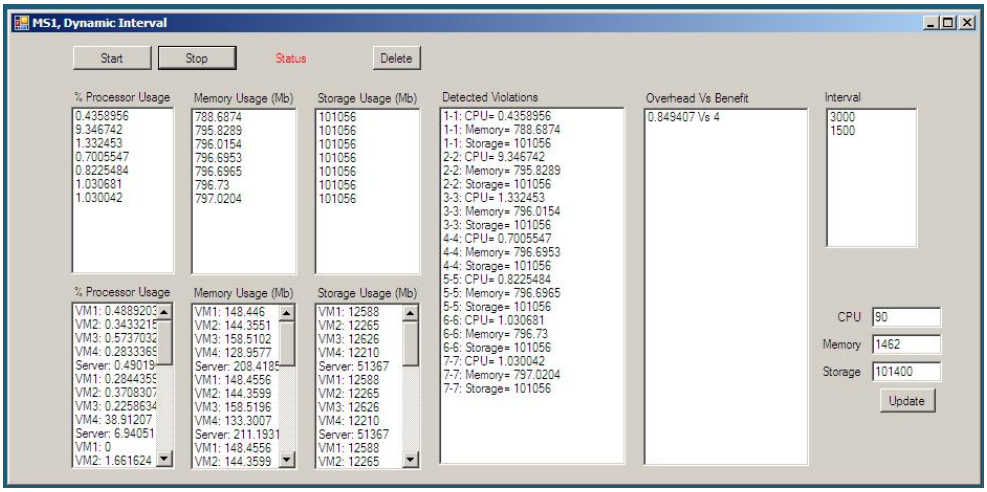

Figure 4: Snapshot of developed SLA monitoring tools

Figure 4 presents the monitoring results of agreed SLA that the CPU, Memory and Storage usage should be more than 90%, 146 MB, and 101400 MB respectively. The resources of 4 VMs are monitored periodically and the total CPU, Memory and Storage usage are also presented. The overhead and benefit of monitoring tools are measured every 5 iteration of SLA evaluation. The monitoring interval value is adopted based on measured cost value, benefit value and proposed DMI formula. The benefit of

monitoring tools is 4 $ versus 0.84 $ cost in first assessment; and the monitoring interval is changing from 3000 MS to 1500 MS.

4 Test bed Experiment

The test bed is developed to provide the experiment environment for running cloud services and executing the developed monitoring tools. Three physical machines are employed producing 4 VMs and 1 Vcenter server as presented Figure 5 Vmware vSpher 5.1 is installed on the server to configure and manage VMs. ESXi 5 is installed on two physical machines as a hypervisor to create the needed VMs. 4 VMs are created and they are managed remotely by Vmware vSpher application from server.

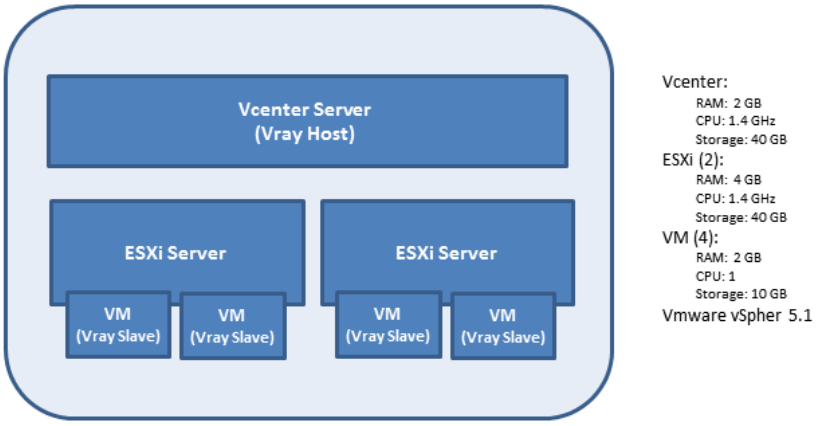

Figure 5: Test bed specifications

V-Ray Host application is installed on the server to do the image rendering process by employing the installed V-Ray Slaves on VMs. V-Ray Host takes the 3dsMax file and distributes the different parts of image to the VMs for rendering process. Each V-Ray Slave renders the assigned image parts and responds the output to the V-Ray Host for finalization of complete rendered image. The developed SLA monitoring system is installed on the server to monitor the VMs. The physical machine server has 2 GB RAM, 1.4 GHz CPU, and 40 GB storage capacities. Each hypervisor contains 4 GB RAM, 1.4 GHz CPU, and 40 GB storage properties which assigns 2 GB RAM and 10 GB storage capacity to each virtual machine.

5 Performance Evaluation

Certain development tools are used to implement the test bed, cloud service scenario, and monitoring tools. The virtualized environment is created by employing the Vmware productions consisting ESXi 5.0 and Vmware vSpher 5.1. ESXi is a hypervisor to manage and assign the resources to the created VMs [6]. Vmware vSpher is employed as a remote application to create and configure the VMs on ESXi. The SLA monitoring tools is developed using Visual Studio .Net. Standard tools and libraries of .NET Framework 3.5 among the functions used, such as System. Threading and System. Diagnostics. Performance. Counter for data collection. Autodesk 3ds Max 2012 and V-Ray Host 2.0 plug-in are installed on the server for running the distributed image rendering on experimental case. The Slave version of V-Ray is installed on each VM for V-Ray Host to delegate tasks. The value of SLA attributes are measured by SLA monitoring tools and the outputs are collected per each employed monitoring interval based on certain criteria setting. The results are presented in forms of scatter graphs for predefined situations. The cost of SLA monitoring tools are calculated based on consumed CPU, Memory, and storage resources for SLA

monitoring execution. A formula is defined and follows for cost calculation. The amount of each resource usage is multiply on the predefined price value per unit to assess the spend cost. The cost assessment formula is:

$$C = St * SCU + Me * MCU + CP * CCU$$

While C refers to the monitoring cost. St, Me, and CP are storage, memory and CPU resources respectively. SCU, MCU, and CCU are the cost units for storage, memory and CPU accordingly. Table 1 presents the predefined price value per unit for each resource usage.

Table 1: Predefined price value per unit

Resource	Price per Unit
Storage	0.04 $ per 1 MB
Memory	0.15 $ per 1 MB
CPU	0.15 $ per 1% Usage

The benefit (B) of SLA monitoring tools are measured based on the number of detected violations (DV) multiplying on the predefined penalty value (PC) in SLA as stated in following formula.

$$\mathrm{B} = \mathrm{PC} * \sum_{i=0}^{n} DV$$

The predefined penalty value is 0.8 $ per SLA violation in all situations. This penalty value is inspired from predefined penalty range of SLA violations [7]. The cost and benefit of SLA monitoring tools is measured at the run time by employing an intrusion code in the test bed [8]. The descriptive statistics is employed for measuring and presenting the cost and benefit of monitoring tools in different situations. The total profit (Pr) of each monitoring tools execution is assessed by deducting the measured cost value from benefit value.

$$Pr = C - B$$

6 Conclusion

The trustable SLA monitoring model is proposed in this chapter. The actors of proposed model included the end user, service provider (SP), and trusted party (TP). The agreed SLAs are recorded in (TP) center and the monitoring engine of TP is located in SP to collect the needed data about agreed QoS. Monitoring engine sent the collected data to the TP center after executing the tasks by employed VMs. The SLA evaluation results and probable detected violations are finally reported to the user. The proposed dynamic monitoring interval (DMI) is also described in this paper. The interval value [9] is adopted based on the cost and benefit assessments of monitoring system. The DMI increased the monitoring interval when the benefit value of monitoring system is higher than the cost value. The monitoring system, on the other hand, decreased the interval value when the measured cost of monitoring system is more than its benefits. Finally a SLA monitoring tools is developed based on proposed DMI to monitor the agreed SLA and adopt the monitoring interval [10] at run time. The experiment test bed and virtualized environment are made ready to prove the model execution. The distributed image rendering service is executed as example cloud service in the test bed, and monitored by the developed monitoring tool. The predefined SLA contains specific SLO values gained from strict

reviews of related works. The cost and benefit values of SLA monitoring tools are measured at the run time using the defined formula.

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Automated Medication System for Rural and War Affected Areas

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ABSTRACT

Robot is machine like human beings working in hazardous situations, replace domain experts and provide accurate results. We proposed automated medication system that work like human physician experts in remote locations, where flood and thunderstorm occurs. It measure patient's temperature and blood pressure using sensors and get input from user via keyboard and voice system. After finding diseases, it retrieves symptoms for diseases from stored databases. The proposed automated medication system provides facility to people which are unable to reach big cities where medical facilities are available.

Keywords: Automated medication system; robot doctor; flood; thunderstorm; war.

1 Introduction

Today robotic technology is useful for work in difficult and critical situations where risk of human life is high. Experts from various fields refuse to work in challenging situations due to possible accident such as human life. They prefer to live risk free normal in metropolitans. In modern times artificial intelligence has made machines useful enough to work almost like human beings. The facilities for humans are easily accessible in major cities where as in rural areas their access is problem because of the distance of rural areas from major cities. Due to insufficient medical treatment resources, health is other major problem in rural areas. In developed countries health services are cheap and easily available on doorsteps. In least developed or war affected countries, it is hard to find a medical specialist. Sometimes thunderstorm or flood situations in countries make life difficult and different diseases are taken places so there is need for doctor to treat patients. Rural areas are away from capital cities and take doctors long time to reach patients for treatment and they have no communication in rural areas. Mostly children, elderly people and pregnant women lose their life. The situation worsens during floods. All roads become disconnected to reach major cities and outbreak of diseases like malaria, diarrhea and fever is occurred which causes mortality in children and elderly people. Therefore it is very difficult for rescue team to reach every patient. According to our research, the solution of this problem is the development of automated medication system that can work on behalf of expert doctors in difficult situations where flood or heavy thunderstorm destroy the area or in case war is held. There is need is to develop an automated medication system that serves in challenging situations to provide facilities to human beings.

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Robot is a machine, which contains sensors, manipulator, control system, database and software that forces machine to take sense or observe the environment, and make decisions like experts to solve the problems. “The term robotics encompasses a variety of research subareas, systems, and applications that span navigation; manipulation; walking, running, and flying; legged, wheeled, and tracked locomotion; autonomous underwater, aerial, and space vehicles; and medical, service, and automation systems”[1]. One subarea of robotic termed as social robots that help for social problems like eye contact, body language and also help to speech and gestures. Now robots share part in human life the mobile robots are used for guide people in museums and robots are also use for driving vehicles few applications of robots use in Physics (nanotechnology) [2]. “NASA tests robots for exploration in areas called analogs. Analogs are places where the environment is similar to locations like Mars or the moon, where a robot may be used. One NASA analog is in the Arizona desert. NASA robotics experts conduct field tests in the desert to assess new ideas for rovers, spacewalks and ground support. Some of these tests are conducted by a team called Desert RATS, which stands for Desert Research and Technology Studies” [3]. The main reason of development of robots for reduce heavy work force from humans and shift that work on machines. Three are two common types of robots used in industries:

1. Fixed robots. 2. Mobile robots.

Fixed robots are usually fixed at one place in industries, where they work as pick and drop things from one assembly line to other assembly line. Robotic arms are used to hold materials at working hours. Mobile robots are more intelligent and have more functionality compared to fixed robots because mobile robots can move from one place to other place. Some examples of robots are, a dancing robot and News anchor robot both developed by Japan. These robot uses sensor, vision, motion and detecting function to work properly in environment. Main components used in robot for performing operations are robotic arm, controller, end effectors, drives, manipulators, and sensors.

Robotic Arm: Robotic arm is used in industrial robots for holding materials. Robotic arm moves in six axes to perform operations, some robotic have less depend on applications where robots are used. The robotic arm also has several other components including wiring, cables, and drives. Typically, the larger the robotic arm, the higher the maximum allowable payload [9].

Controller: it is the brain of robot. It controls the robotic arm and all other operation which robot performs. User can input data and control for task by using controller of robot [10].

Drives: Drives are the servo-motors of robot which play part to move robot from one place to other place and move the robotic arm required direction in industry [11].

End Effectors: End effectors are made on the end of robot arm used as gripper or holding the materials. End effectors have many shapes, sizes and unique according to their applications like cutting, painting and welding [12].

Sensors: Sensors are environment sensing devices and reacting on the observations from surroundings. Sensors are uses in robots for visioning, quality control temperature, pressure, fire smoke detection and detecting current position in working area [13, 14].

Expert systems are the part of artificial intelligence which contains knowledge of domain experts for assist juniors in work. Experts system didn’t collects data of user by using sensors but they only respond user’s queries. The inference engine contains mechanism of expert system which follows the rules and

procedure a logical reasoning for answer. Current robot doctors (Robot machines) assist the physician and medical staff by taking automatically temperature, blood pressure, heartbeat rate and pulse rate. Robot doctors currently used in hospitals didn't provide any symptoms solution to patient in normal or emergency situations. The development of good decision system of robots that make accurate decision, provide accurate result in practical environment and provide facilities to patients to communicate easily or share information about their diseases easily. In this paper we propose automated medication system which is combination of expert system and new robot doctors. Automated medication system take input from user and automatically measure temperature and blood pressure of patient and provide accurate symptoms for treatment.

This paper is divided in IV sections, II section contains background of previous development in robotic technology, the III sections illustrate proposed automated medication system and finally we conclude work in section IV.

2 Literature Review

Robotic technology is used in hospitals for patient care, surgeons use for accurate surgeries of patients. In USA hospitals the paralyzed patients from neck to down have been able to control a robotic arm using their thoughts. In figure patient drink first time in nearly 15 years [4].

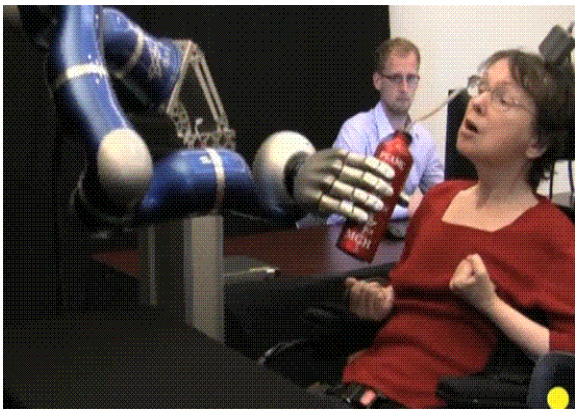

Figure 1: Paralyzed patient drinking using robotic arm

A researcher from USA designed wheelchair-mounted robotic arm (WMRA) for patients to meet the needs of mobility-impaired [5]. The development of this robotic wheelchair with robot arm provides help them to easily move things using robotic arm, they cannot move forward from wheel chair to open a door. Researcher also integrated brain computer interface (BCI) this system measures the brain activities and transform them to control signals for the control of WMRA. In [6] Juan Fasola proposed spatial language communication model in robots for home usage of robots. Robots with natural language processing system work in home with non-expert users. This proposed model provides new research track that enables robots to communicate with non-expert people and have provide facility to them in home. Mirror Image Movement Enabler (MIME) robot developed by Peter for shoulder and elbow neuro-rehabilitation in sub-acute stroke patients [7]. Development of MIME robot provides good therapy results, it is cheap and no tiredness like therapist who continuously move the shoulder and elbow of patients.

In Northern Ireland Telepresence, robot is used for patient health care. Telepresence robot will be used Daisy Hill hospital; it enables doctors to communicate with patients from remote locations using robot visual system. Robot can share huge data of patients with doctors in charts and graphs. Robot has functionality of stethoscope at the back of robot for listening the patient's lungs and heart [8]. In figure 2 design of robot is given.

Figure 2: Telepresence Robot working in Daisy Hill hospital

Robots are used in so many other applications of health caring for provide facility to patients and make job easy for doctors. Robots are still controlled by operators for performing health care tasks but no standalone robot is developed yet which check patient and provide accurate medical symptom for cure his/her disease.

All previous automated medication system s were made for different treatments and few of them only assist or collect data for doctors. The proposed architecture will be standalone robot system which works like expert physician doctor in rural areas or during floods and thunderstorm.

3 Proposed Architecture of Automated Medication System

In this paper, we proposed automated medication system for treatment of diseases which occurred in rural area when flood or thunderstorm occurred. The proposed automated medication system works like physician and assist patients for usage of symptoms for treatment cure from diseases. The proposed system depends on sensors, database, processing unit, storage, network connection and user interface (input & output).

In development of automated medication system process we conduct interview and collect data from physician for diseases (fever, dehydration, Malaria, headache etc.) that occurred during the flood and thunderstorm. All information regards to diseases and treatments are store in database and MySQL database is used for automated medication system. Sensors are the main part of automated medication system which collects information in shape of body temperature of patient and blood pressure. Inference engine is responsible for process all operation from getting information from patient about their disease and find suitable treatment for patient. Automated medication system is connected via network connection to central hospital system for analysis of database and updating of database. User interface is used to help to patient communicate with robot system for input information in system.

Input and output system is an important part of automated medication system. Keyboard is used to input the data. All components of automated medication system are given in figure 3.

User starts using automated medication system service to input of temperature and blood pressure. Sensors measure the body temperature and blood pressure of patient. Patient has option to use user interface to input disease or health problem that causes illness. System provides a unique ID for every patient and stores his all information in database for future usage. For example, patient enters data of diseases from keyboard then system find out keywords or fetches names of diseases from user's data. After finding the keyword of diseases, system software will find symptoms for every disease from database which depends on knowledge of ten (10) expert physicians. Final output of automated medication system will provide list symptoms for patient in printout on paper. All automated medication systems are connected to central system for sharing information of patient's facts and figures. After certain time period, all automated medication systems database will be updated with latest diseases and their treatment symptoms because every day new research in medical field find new symptoms for diseases which provides quickly relief to patient from illness.

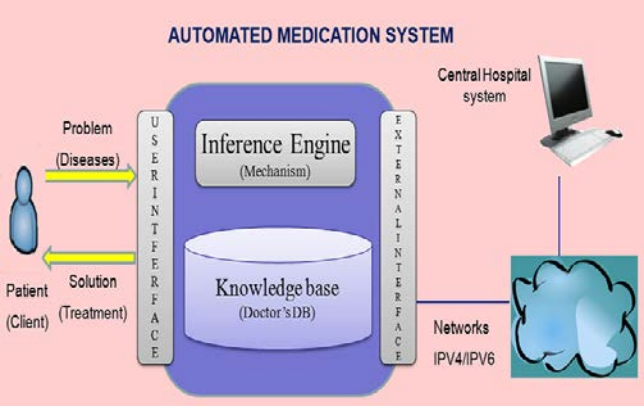

Figure 4: Proposed Automated Medication System architecture diagram

4 Results and Discussion

This section contains results of databases which include main database of automated medication system and Patient information database. The main database of automated medication system contains columns of disease, symptom and ratings. Disease columns stores information of all diseases and symptom columns stores data of symptoms and their types it's tablet or syrup. The rating shows number of experts prefer symptom out of 10 given in figure 4. The database tested with running different search queries like disease name, symptom name as well as ratings. Figure 5 is SQL query execution and figure 6 contain the result of SQL query.

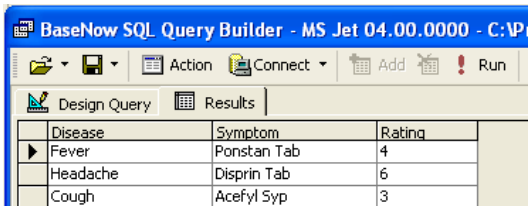

Figure 5: Snapshot of Automated Medication system DB

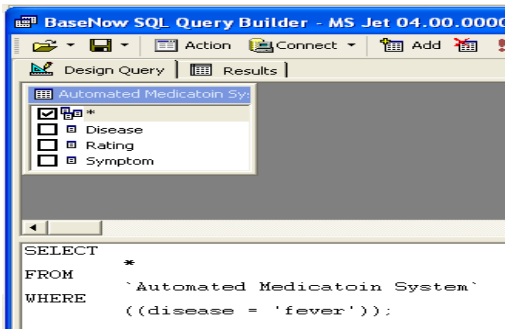

Figure 6: Snapshot of SQL Execution

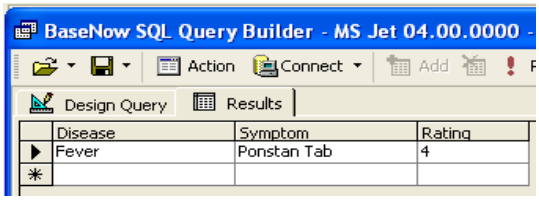

Figure 7: Snapshot of result

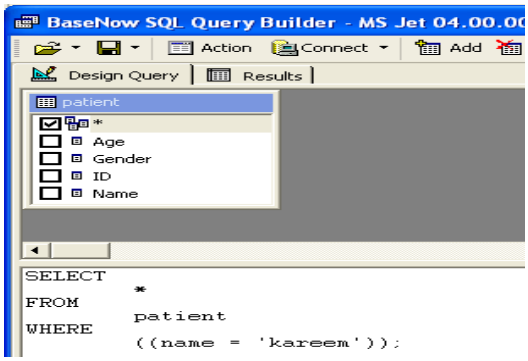

Figure 8: Snapshot of SQL query execution

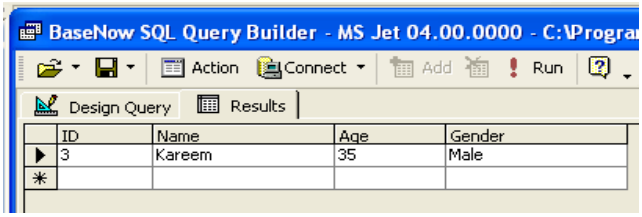

Figure 9: Snapshot of result of patient's table

The user interface is given for user input about diseases. The user interface is required three steps for symptoms required for treatment of the patients. In figure 10: user interface display automatically collected information of blood pressure and blood pressure of patient. The system automatically assigns ID to every new user for identification and future use for system. User will enter his details name, age, gender and diseases from the suffering and page also contain option for information submit or cancel and reset page.

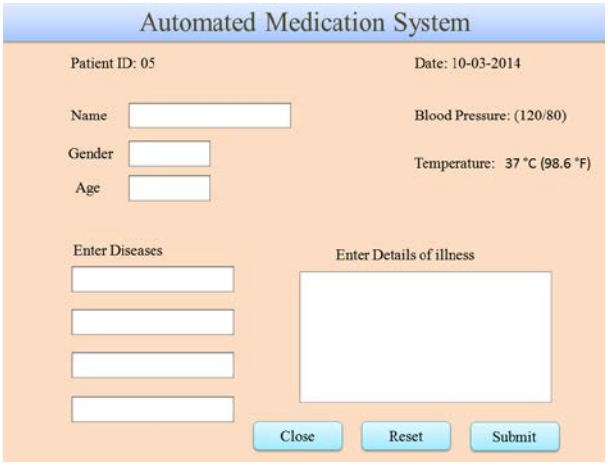

Figure 10: Snapshot of result of user interface

After the pressing the submit button in first user interface form given in figure 10. , 2nd user interface page will open. This page ask question from patient about the major diseases in figure 11.

Figure 11: Snapshot of result of user interface

Finally system will display page contain symptoms of diseases which entered by patient and the time when symptoms can be taken.

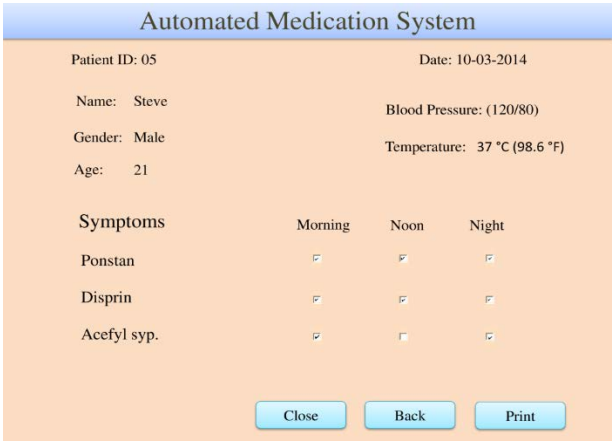

Figure 12: Snapshot of result of user interface

5 Conclusion & Future Work

The proposed automated medication system is an integration of previous robot doctors, which assists the domain experts by taking temperature, blood pressure and hurt beat rate by adding features of expert systems. The proposed system is standalone system, which provides facility of first aid for the patients with less mobility in large hospitals during disasters, e.g., flood, thunderstorm and war situations.

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The Bidirectional Long-Short-Term Memory Neural Network based Word Retrieval for Arabic Documents

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ABSTRACT

The reflow from Arabic document image collections is a challenging task. This is partly due to the insolubility of the Arabic script. Because of the peculiarity of the whole body of the Arabic words, namely connectivity between the characters, thereby the segmentation of An Arabic word is very arduous and also the variability of the handwritten styles and shapes as well as deceleration in the print therefore Arabic document repositories are not liable to indexation and reflow. In this paper, we are proposing an idea for reflow coherent Arabic document in response to an appropriate Arabic query word. We present a novel approach at reflow on an Arabic document image, using a Bidirectional Long-Short-Term Memory Neural Network. The designed to take relating to information into account, these networks can maintain Arabic word images that cannot be durable segmented into individual Arabic characters. The partitioning Arabic word, we easier the problem and receive elevated reflow rates. The proposed capable reflow scheme avoids unambiguous recognition of Arabic characters. An experimental evaluation on a dataset of Arabic word images conjunct from handwritten notebook show good precision even in the impendence of printing transformation and deceleration. The reflow Arabic word performance is comparison with baseline methods. These results encourage the development of real world systems for word reflow for Arabic documents.

Keywords: Arabic Script, Dynamic Time Warping (DTW), Word Spotting, Segmentation, Bidirectional Long-Short-Term Memory Neural Network (BLSTMNN), Euclidean Distance.

1 Introduction

Today scenarios there are two famous viewpoints to building search systems over document image collections firstly the optical character recognition (OCR) and secondly the word spotting. The optical character recognition has been applied to real life problems in many industries for a number of decades. But optical character recognition typically work well for distinctly documents and face severe arduous in character segmentation and recognition [1] in the presence of digression. Further, the robust optical character recognition is not yet available for many Arabic languages [2], which have an extended character set with a complex script layout. The word spotting approaches [3] overcome some of the drawbacks of optical character recognition. In word spotting segmentation at the Arabic word level is much more accurate than character/component segmentation since degradations typically do not impress the inter-word spaces [4]. The queries as well as the database images are transformed into a

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sequence of feature vectors and compare is oftentimes carried out with the help of Dynamic Time Warping (DTW).We use Bidirectional Long-Short-Term Memory Neural Network for word spotting in this paper [5]. We extend these methods for word spotting in handwritten Arabic documents. Bidirectional Long-Short-Term Memory neural networks are recurrent networks with hidden layers consisting of long short-term memory [6] blocks. Bidirectional Long-Short-Term Memory neural network transform a sequence of feature vectors into a sequence of character class likelihood [7], and thereby building an mesne representation which is used for word spotting. In this paper, we demonstrate the well-turned use of a Bidirectional Long-Short-Term Memory neural network for printed Arabic documents. The main focus is on restitution from a collection of documents written in Arabic, a script for which robust and credible optical character recognition system do not exist. Bidirectional Long-Short-Term Memory neural networks are competent of, and matching of feature a vector which does not scale to huge number of data sets. We show our method on a couple of handwritten books in Arabic.

2 The Arabic Script

The Arabic script evolved from the Nabataean Aramaic script. It has been used since the 4th century AD, but the earliest document, an inscription in Arabic, Syriac and Greek dates from 512 AD [8]. The Arabic one of the six official languages of the United Nations, Arabic is a Semitic language spoken by between 300 and 400 million native speakers, and a further 250 million non-native speakers, in nearly twenty countries in the Middle East and North Africa. Arabic is quite a challenging language to learn for a number of reasons: it uses a number of sounds pronounced way back in the throat that can be tricky for speakers of English and other languages [9]. It is written with a cursive alphabet running from right to left in which the letters change shape depending on their position in a word [10]. The words consist of connected components or sub-words, and these are often called fragment of Arabic words in the literature. In Arabic script, there is no difference in the within word space and the between words space in figure 1.

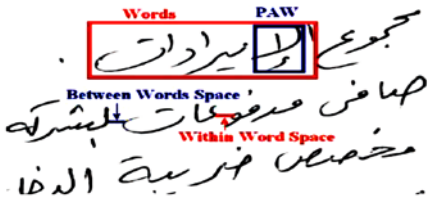

Figure 1: Arabic Script between Words Space

This lack of apparent boundaries between words, together with the fact that Arabic writing is naturally cursive and more voluntary than in other languages, make word spotting [11] in the Arabic language a challenging task in need of further research. Arabic word spotting approaches tend to segment documents into fragment of Arabic words rather than words, and then find ways to rebuild the words from the fragment of Arabic words. In this paper there may not be a sufficient number of examples of each class present in the training set. To avert incorrect restitution we are asiphon appropriate strategy. The Arabic words are mark out by a connecting top line, one of the famous initial steps in recognizing Arabic is to erase this line. This separates the vowel modifiers which span the top-zone from the middle zone. This is explained in figure 2.

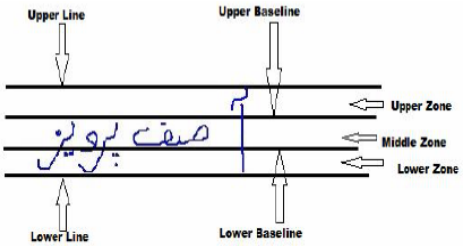

Figure 2: The Arabic word Script and its upper, middle, and lower zone

Similarly the lower zone is also erased. This mitigates the number of character classes to be recognized. We are interested in spotting words, or retrieving occasional Arabic documents analogous to a query. We take an intermediate route between exhaustive recognition and feature based Arabic word spotting in this work.

3 The Word Spotting

The word spotting is viewpoint that traditionally viewed as an image matching task between one or multiple query word-images and a set of candidate word-images in a database [12]. The goal is to greatly detract the amount of annotation work that has to be propitiate, by grouping all words into clusters. The each cluster contains words with the same remark. Once such a clustering of the data set exists, the number of words vested in a cluster can be used as an indication for determining the weightage of the word as a query term. The various systems have been compared in and showed that the best precision was obtained with the system based on Dynamic Time Warping an algorithm for measuring equality between two sequences which may vary in time or speed [13]. The word spotting can be classified in two type firstly the segmentation-based, and secondly the segmentation-free approaches. In segmentation-based approaches require each document image to be segmented at word level, taking advantage of the knowing of the structure of a document. In Segmentation-free approaches the image is divided into patches and the query word image is classified about each patch. Since all the regions are compared, these systems are computationally costly in terms of time [14]. In this paper, we are proposing word spotting based on a lately evolved recurrent neural network, termed bidirectional long short-term memory (BLSTM) neural network. The word spotting in the Arabic script dates back several years [15] when we unfortunately offered little work and solutions for handwritten Arabic script.

4 Dynamic Time Warping

In the year 1983, Joseph Kruskal and Mark Liberman [16] introduced a new technique to compare two curves (calculate the distance between them). The technique, that they called time warping, made it possible to make a matching between two curves that are subject not only to alteration by the usual additive random error but also to variations in speed from one portion to another. A guileless approach to comparing two time-variant feature vectors is to align one vector to the other, column by column, and computing the distance between the two. This viewpoint would perhaps get confused by the compression and expansion effects that “time” has on the features. The dynamic time warping takes care of this problem by compute the optimal time-warped alignment of the two feature vectors and the compute their distance. In figure 3, each vertical line connects a point in one time series to its correspondingly similar point in the other time series.

The lines have identical y-axis values, but have been separated so the vertical lines between them can be viewed more readily. If the two time series in figure 3 were identical, all of the lines would be straight vertical lines because no warping would be necessary to 'line up' the two time series. The warp path distance is the sum of the distances between the corresponding points. Thus, two time series that are identical except for localized stretching of the time axis (as in figure 1) will have warp path distances of zero [17]. The Dynamic time warping is an illustration of a dynamic programming problem. To compute the dynamic time warp, the first feature vector $f^{(1)} \epsilon R^{\{M,1\}}$ is lined up against the second feature vector is $f^{(2)} \epsilon R^{\{1,N\}}$ and the M x N distance matrix D(., .) is computed between every element in $f^{(1)}$ and $f^{(2)}$. The each D (i, j) element is computed according to the following formula where cost (f i (1), f j (2) is the distance between the f (1) (i) and f (2) (j).

$$D(i,j) = cost(f_i^{(1)}, f_j^{(2)}) + min \begin{cases} D(i,j-1) \\ D(i-1,j) \\ D(i-1,j-1) \end{cases}$$

The final DTW-distance is the value at D(M,N) and the feature element to element warping-correspondence is found by tracing back from D(M,N) to D(0, 0). It is important to note that the Dynamic Time Warping constructs a matching path in a more complex way.

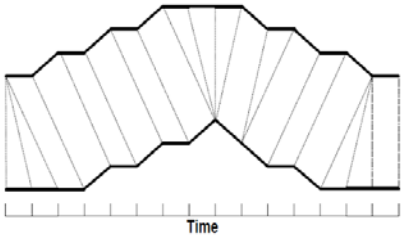

Figure 3: A Warping between Two Time Series

It is based on linear matching, but has four conditions or constraints (of which three are optional) that need to be satisfied. These conditions are called the continuity condition, the boundary condition, the monotonicity condition and the penup/pendown condition.

4.1 The Continuity Condition

The continuity condition decides how much the matching is allowed to differ from linear matching. This condition is the core of the Dynamic Time Warping and thus is not alternative. For some warping path w = [w1w2...wK] wk = (i, j) then wk−1 = (i`, j`). Where i − i` ⩽ 0 and j − j` ⩽ 0. Thus, the allowable warping path is limited to adjacent cells. In figure 4 shows how this condition puts a constraint on the matching path. In this matching path, the matches corresponding to the crossed squares in the path are prohibited by this condition.

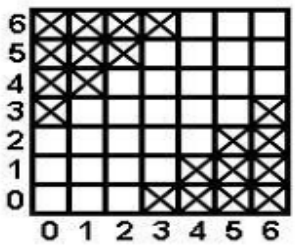

Figure 4: The Continuity Condition

4.2 The Boundary Condition

The boundary condition, if turned on, forces a match between the first points of the curves and a match between the last points of the curves. If this condition is turned on, the named points are matched, whether the continuity condition agrees or not and whether the points are nearest or not. The warping path must start D (1, 1) and end at D (M, N). In figure 5 shows how this condition puts a constraint on the matching path. The first points of the two curves and the last points of the two curves are forced to match.

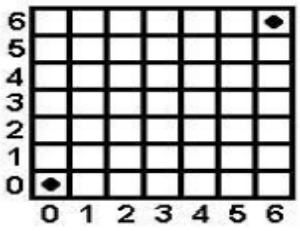

Figure 5: The Boundary Condition

4.3 The Monotonicity Condition

The monotonicity condition is a condition that inhibits the matching from "going back in time". If at some point in the matching process it is decided that the i^{th} point of the first curve matches with the j^{th} point of the second curve, it is not possible for any point of the first curve with index > i to match with a point of the second curve with index < j^{th} and for any point on the first curve with index < i^{th} to match with any point on the second curve with index > j. $w_k = (i, j)$ then $w_{k-1} = (i`, j`)$. Where $i - i` \geq 0$ and $j - j`$ _≥0. Thus, w is monotonically spaced in time. In figure 6 illustrates this condition. After the matching of the 5 shown point combinations, the matches corresponding to the crossed squares in the path are prohibited by this condition.

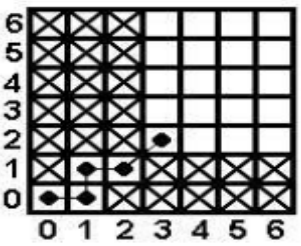

Figure 6: The Monotonicity Condition

4.4 The Penup/Pendown Condition

The penup/pendown condition ensures that pen up points of the first curve (points of which the z coordinate, which represents the pen pressure > 0) can only match with pen up points of the second curve, and that pen down points of the first curve (points of which the z coordinate <= 0) can only match with pen down points of the second curve. In figures 7 c and d show the matching of the allograph in figures a and b, with the stipulation turned off and on, respectively. As can be seen, the matching with the stipulation turned on is more natural than the matching with the stipulation turned off. Using the stipulation, the classifier can make a better distinction between allograph that have or do not have pen up points. The DTW is frequently used in handwriting recognition and also used in many other

disciplines including data mining, gesture recognition, speech recognition, robotics, manufacturing, and medicine [18].

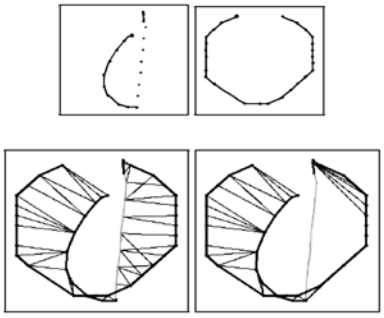

Figure 7: The Penup and Pendown Condition

5 Proposed Bidirectional Long Short Term Memory Neural Network Arabic Script Spotting System

The term Bi-directional computation means that two signal transformations, which are direct and inverse transformations exits and their performance is improved through their coupling effects. A Bidirectional neural networks model, it consists of two sub networks and can deal with two kinds of signal transformations Bi-directionally. The Bidirectional recurrent neural networks [19] are composed of two recurrent network layers, whereas the first one processes the sequence forwards and the second one processes it backwards. The both networks are connected to the same output layer, the Bidirectional net has reach to the total information about past and future sequence data points [20]. During training, the amount of contextual information that the network uses is learnt and does not have to be specified manually [21]. BLSTM neural networks make use of an arbitrary, Self- learned amount of past and future contextual information. Bidirectional networks can be applied whenever the sequence processing task is not truly online [22] in other words meaning the output is not in need after every input which makes them famous for speech recognition tasks where the output has to be present e.g. at the end of a sentence.

A drawback of conventional bidirectional RNN architectures is that the range of context that can actually be accessed is limited as the influence of a given input on the hidden layer either decays or blows up exponentially over time (vanishing gradient problem) [23]. An effective viewpoint to overcome the vanishing gradient problem is the Long Short-Term Memory architecture, which is able to store information in linear memory cells over a longer period of time and can learn the excellent amount of contextual information relevant for the classification task [24]. A Long Short-Term Memory layer is composed of recurrently connected memory blocks, each of which contains one or more recurrently connected memory cells, along with three multiplicative “gate” units firstly the input, secondly output, and thirdly forget gates. In figure 8 shows the architecture of a simple Long-Short-Term Memory block consisting of a single memory cell. The gates execution functions analogous to read, write, and reset operations. The cell input is multiplied by the activation of the input gate, the cell output by that of the output gate, and the previous cell values by the forget gate. Their influence of is to allow the network to store and retrieve information over long periods of time [25]. If example the input gate remains locked, the activation of the cell will not be overwritten by new inputs and can therefore be made available to

the net much later in the sequence by opening the output gate. This theory clear up the vanishing gradient problem and gives access to long range context information.

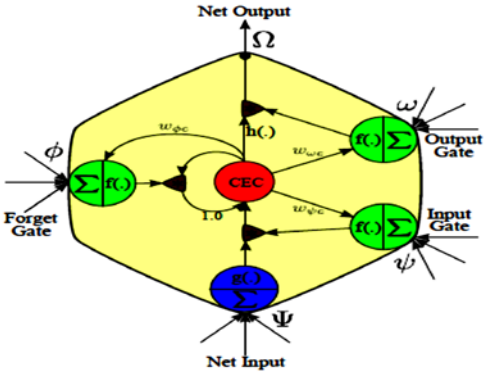

Figure 8: The LSTM Memory Block Consisting of One Memory Cell

The calculation of the activations in the forward pass of a single Long-Short-Term Memory cell is carried out in pursuance of the following procedure. The subscripts ψ, Φ, ω refer to the input gate, forget gate, and output gate, serially ψ and Ω to the net input and output of the cell. The c mentions to the memory cell and a_c to its state value. The output Ω of the single Long-Short-Term Memory cell is connected to other cells in the network.

1. The calculation of the activation O_ψ (T) of the input gate with I containing all input units connected to the cell and H containing all hidden cells. The activation of the forget gate O_Φ (T) = f (α_Φ (T)) is computed analogously.

$$o_\psi(\tau) = f(a_\psi(\tau))$$
$$a_\psi(\tau) = \sum_{i \in I} w_{\psi i} x_i(\tau) + \sum_{h \in H} w_{\psi h} o_h(\tau - 1) + w_{\psi c} a_c(\tau - 1)$$

2. The calculation of the activation of the net input unit Oψ (T) = g (α ψ (T)), which receives current activations from the input units I and activations from the hidden units H one time step back.

3. The calculation of the cell state α c (T)

$$a_c(\tau) = o_\phi(\tau) a_c(\tau - 1) + o_\psi(\tau) o_\Psi(\tau)$$

4. The calculation of the activation of the output gate O_ω (T) similarly to the other gates, but using the current cell state α_c (T)

$$o_\omega(\tau) = f(a_\omega(\tau))$$
$$a_\omega(\tau) = \sum_{i \in I} w_{\omega i} x_i(\tau) + \sum_{h \in H} w_{\omega h} o_h(\tau - 1) + w_{\omega c} a_c(\tau)$$

5. The calculation of the cell output O_Ω (T)

$$o_\Omega(\tau) = o_\omega(\tau) h(a_c(\tau))$$

The most probable sequence of Arabic characters is given by selecting the character with the highest likelihood for each step in the sequence. Latterly, this character sequence requirements to be shortened. We work with Arabic word images instead characters and lines. We are take an interest in retrieving documents based on queries which are in the first instance of Arabic words. In this paper first of all Arabic document images are segmented into words. The top line connects the entire Arabic word and increases the number of presumable shapes to be recognized, we segment the Arabic word by deleting top line. This process done with the help of a horizontal projection. We delete the top and bottom region and work with the midst region. This can result in sparing of the accuracy at the same recall. After that the garble the veracity labels sequence of the images to obtain the corresponding veracity after region it in the midst. In next phase deleting upper and lower region, each image is demonstrate as a sequence of feature vectors. No need require any further segmentation of the Arabic word images. They build the procedure powerful to the exemplary cuts and merges seen in the Arabic document images. In this paper our experiments, we use features extracted from vertical stripes of uniform length. We are extracting different feature firstly the upper and lower profiles measure the switch over of the top and bottom foreground pixel from the related Arabic word baselines. Secondly the printed background color transformation measures the number of transformation from printed to background and inverse.

The number of black pixels endows the information about the density of printed background in the vertical stripe. They input series of feature vectors are fed to the network for training all in all with their corresponding label sequences. If the system is trained after that utilization of the neural network output probabilities to return the most suitable label series for given test series. Finally, the entire Arabic database images are stored as the corresponding output label series returned by the neural network for Arabic word retrieval; these output labels are equality with the interpellation Arabic image label series. The combination of bidirectional networks and LSTM is called bidirectional LSTM, which has demonstrated wonderful performance in phoneme recognition keyword spotting, handwriting recognition and emotion recognition [26].

6 Experimental Results of Bidirectional Long Short Term Memory Neural Network Method for Arabic Script

In this section we present experiment performed to evaluate our method, and we show the results obtained and it is also comparing the performance against baseline prescript using Arabic script. We have performed two tests and evaluate their performance. In the first usage, we contemplate a two Arabic handwritten notebook in other words; it's also called AHN1 and AHN2 for testing and training. For second usage using trained AHN1 and AHN2 and test on another third Arabic handwritten notebook (AHN3) these Arabic notebooks are remark at the Arabic word level. In the first Arabic handwritten notebook (AHN1) contain 76 pages, 1640 lines, and 18304 Arabic words. Second Arabic handwritten notebook (AHN2) contains 91 pages, 2170 lines, and 22304 Arabic words as well as third Arabic handwritten notebook (AHN3) contain 113 pages, 2409 lines, and 24821 Arabic words, all three notebooks for using testing and training. In the first test, the Arabic document images were scanned and segmented into Arabic word images. In this paper, we are trained the network using the training set and the validation set to adjudicate the stopping criteria during the iterative training process.

Table 1: The Inside Lexicon and Outside Lexicon Queries

Queries	A	Mean Average Accuracy (MAA)
Inside Lexicon	93.85	85.79
Outside Lexicon	93.13	83.37

As Input every Arabic word image in the test set is given to the trained network. The network outputs a most probable sequence of labels for each Arabic image with the help of output possibility. We are utilizing 15% as the validation set and 70% of the images as the training set and the remaining 15% were used as a test set. In the next section count the edit distance from the query words for Arabic word retrieval. In this section first set contains words which already exist in the training set, it called inside lexicon and second set contains words which do not exist in the training set it called outside lexicon.

Table 2: A Comparison with the Euclidean Distance, DTW and BLSTM Model

Method	A	Mean Average Accuracy (MAA)
Euclidean Distance	79.43	72.57
Dynamic Time Warping	85.31	78.81
BLSTM Prescript	92.89	85.93

Here A represents the accuracy at a recall rate of 60%. Mean Average accuracy (MAA) is the mean of the area under the accuracy recall curve for all the queries. The results of inside lexicon and outside lexicon queries are shown aside in table 1. In another test using an Arabic handwritten notebook and trained the neural network on AHN1 and AHN2 and tested on AHN3. In the retrieval some operation performed firstly count their edit distances from the rest of the Arabic test images using their label sequence representations. Secondly, count the accuracy at a recall rate of 60%. We got MAA about 85.93% on this test. The appropriate results of proposed prescript are shown in Table 2. The Accuracy recall curve corresponding to the BLSTM is shown in Figure 9. We compare appropriate results with word spotting prescript with DTW in this case feature vectors are the homogeneous. An additional compare results using Euclidean distance.

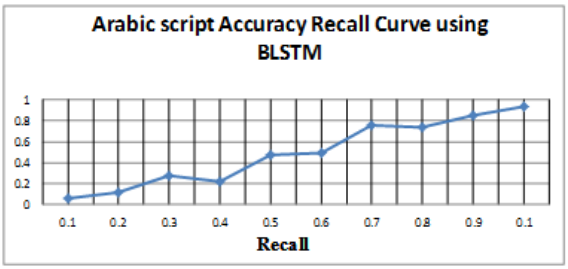

Figure 9: The Arabic Script Accuracy Recall Curve uses BLSTM

The Euclidean distance is the distance between two points in Euclidean space that one would measure with a ruler, and is given by the Pythagorean formula. Euclidean space was originally devised by the Greek mathematician Euclid around 300 B.C.E. to study the relationships between angles and distances. This system of geometry is still in use today. Euclidean geometry specifically applies to spaces of two and three dimensions. However, it can easily be generalized to higher order dimensions.

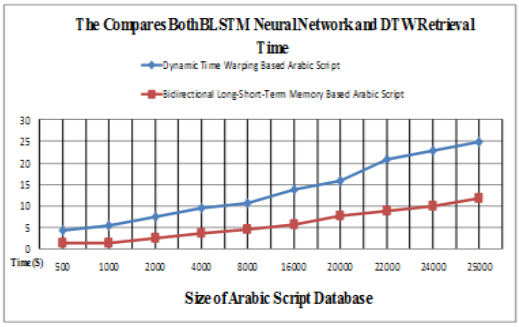

Figure 10: The Compares Both BLSTM Neural Network and DWT Retrieval Time

For Euclidean, all Arabic words are normalized to the homogeneous width. Its show the comparison of the BLSTM neural network rooted prescript with DTW distance and Euclidean distance rooted approach in the Table 2. It may be noticed that the proposed prescripts are better at retrieving episodic Arabic words. The plot in figure 10 compares the retrieval time for both Bidirectional Long-Short-Term Memory neural network prescript and Dynamic Time Warping rooted retrieval. It is distinctly notice that the BLSTM neural network rooted prescript is intensely than the DTW rooted matching and search process because DTW is the heavy computational burden required to find the optimal time alignment path.

7 Conclusion

In this paper, a word retrieval scheme for Arabic document is presented. Today scenario Arabic document recognition is exceedingly arduous to automate. The humankind being can diagnosticate variegated objects and make cognition out of volumetric amount of visual information, seemingly requiring very diminutive attempt. The emulate task execution by humankind to diagnosticate to the extent allowed by physical barricades will be extremely gainful for the system. The difficulty contains in the real world data handwritten Arabic alphabets, where handwritten Arabic characters are the input to the system, while in print characters will be goal output of the system. In this paper, we proposed a novel approach at reflow on an Arabic document image, using a Bidirectional Long-Short-Term Memory Neural Network (BLSTMNN). The designed to take relating to information into account, these networks can maintain Arabic word images that cannot be durable segmented into individual Arabic characters. The partitioning Arabic word, we easier the problem and receive elevated reflow rates. In this paper queries as well as the database images are transformed into a sequence of feature vectors and compare is oftentimes carried out with the help of Dynamic Time Warping (DTW). The favorable outcome originates from a well-balanced system. We outshine a sophisticated recognition technique for the retrieval task. On the contrary, by avoiding a complete recognition, and bypass the challenges posed by the Arabic script. In the future, we would like to evaluate different features of this network and also use a various language model and dictionary based post-processor to ameliorate the with more precision. We would also like to enlarge our work towards recognition of other various languages.

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Learning Style Classification Based on Student's Behavior in Moodle Learning Management System

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ABSTRACT

In learning field, each student has his own learning style that affects his way of get, process, understand and percept information. Determining the learning style of students enhances the performance of learning process. Two methods are commonly used to acquire student's learning style: static by questionnaire and dynamic by tracing student's navigation on e-learning environment.

In this paper, a new approach to classify students dynamically depending on their learning style was proposed. This approach was experimented on 35 students for Data Structure online course created using Moodle. By extracting students' behavior, data from Moodle log, the learning style for each student was identified according to Felder and Silverman model. Also, learning style based on the behavior have been compared with a quiz results conducted at the end of the course.

Receiver operating characteristic (ROC) curve have been used to evaluate the quality of classification results comparing with quiz results. Good results with average accuracy of 76% are achieved. Students' data have been divided into four training and testing sets with different splitting ratio. Different testing accuracy values are obtained for the different ratios using each dimension of Felder-Silverman learning style model (FSLSM).

Keywords: E-learning, Moodle, learning styles, Felder-Silverman learning style, classification.

1 Introduction

Many studies in cognitive psychology indicate that each person differs in the ways in which he/she uses to analyze the information. With the development of psychological studies, there is an increasing desire to study the differences in getting and processing of information.

In the environment of education, there are many ways of thinking, analyzing information, and solving problems. Every student has a personal way to get, handle and understand the information that called student's learning style [1]. For example, some students prefer to learn by seeing graphs, pictures and presentation; some others like to learn by listening; some others like to learn by doing experiments.

Knowing the learning style of students will help educators to provide the learning content in an appropriate format that matching the student's learning style to get greater learning process [2]. There are many ways to know student learning style. The most popular method is the questionnaire. Acquiring student's learning style from this static method is time consuming and may be not accurate [3]. After the

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emergence of e-learning and using Learning Management System (LMS) in education, it becomes more appropriate to acquire the learning style of students dynamically and indirectly while they navigate through e-learning environment.

In this experiment, Moodle LMS was used to develop Data structure course which is a foundation course for computing study. Data Structure course has rich course topics that can be represented using different component forms provided by Moodle LMS such as texts, graphs, animation, exercises. Also, interaction between students are possible by using forums, so student can post topics and reply to others. At the end of the course, quiz should be conducted. 35 students in computer science department were involved in the study. All student activities through the course are stored in Moodle LMS log and the wanted features can be extracted any time.

In this research, we want to identify learning style of students dynamically based on their behavior within the course and compare these styles with the quiz results to evaluate the proposed approach.

This research is organized as follows: section 2 provides background material. Section 3 presents related work. Section 4 describes the system model. Section 5 is methodology and experiment. Sections 6 discuss the results of the proposed system. Section 7 gives the conclusion of the study and the future work.

2 Background

Learning is known as procedures that the teacher used to achieve some relatively permanent change in how students think in obtaining useful information in a short and clever way [4]. Learning is divided into two major categories: traditional learning and e-Learning. Traditional learning is a simple oral spelling where students sat quietly at their places, listened carefully to the teacher whose primary task is assigning, and listening to his students, find out their mistakes and inform them about the correct ideas [5]. E-Learning is a set of learning services and technology tactics aim to provide high value full learning; anytime, anyplace [6].

2.1 Learning Styles

There are many learning styles applicable to both traditional learning and e-learning, which can be described as a set of characteristics and behaviors that define the way of learning [7]. Different styles affect the form that learners learn, how they can interact in interactive methods with learners. Each style has its features and does best in certain circumstances. Learning styles contribute to improve the performance of both teaching and learning process, so that the teacher, using learning styles, can affect not only the way used to deliver the information easily, but also can effect emotionally on his students. As a result, the course will be likable for the students even in case of lack in physical and financial possibilities.

Several learning style models have been used to identify students' learning styles such as Felder Silverman Learning Style Model (FSLSM), Dunn and Dunn model, Honey and Mumford, Kolb's theory of experimental learning and Howard Gardner Multiple Intelligence. FSLSM [7] is used in this study to detect students' learning style. The reason of choosing FSLSM is that the development of the hypermedia learning system with incorporated learning components including navigation tool, different forms of presenting course materials (graphics, video, sound) is suitable to the dimensions of this model.

This model categorized student's learning styles into four dimensions. Table 1 summarize the characteristics of learners based on these dimensions.

Table 1: Felder Silverman learning style model dimensions [7]

Processing dimension: Describes the processing of information	
Active	**Reflective**
Learners impart by making something with the Information. They need to talk about information to process it.	Learners impart by thinking about Information. They prefer to think and understand before doing anything.
Perception dimension: Describes the perceiving of information	
Sensing	**Intuitive**
Learners impart by focusing on details, facts, figures and dealing with proven functions that have real applications.	Learners impart by focusing on abstract, initial, and theoretical information. They take a big picture, extract models and connections among ideas and these models.
Input dimension: Describes the presenting of information	
Visual	**Verbal**
Learners impart by focusing on diagrams, charts or anything can present information.	Learners impart by focusing on explanations by written or spoken sentences.
Understanding dimension: Describes the understanding of information	
Sequential	**Global**
Learners impart by focusing on managing information in a linear way and dealing with logic and followed steps.	Learners impart by focusing on dealing with information in the historical way, they don't concern about both organizations of information and relationships among it.

Felder and Silverman have developed Index of Learning Style (ILS) questionnaire that consists of 44 questions with two possible answers, A or B. This questionnaire used to determine the learning style of students explicitly [8].

2.2 Learning Management System (Moodle)

LMS is a system aims to support learning content development depending on the web. LMS has many features including course creation, information delivery, students' enrolment and navigation tracking [9]. In LMS, educators can deliver the information to learners; create course materials, conducting exercises and quizzes. In addition, they can manage learning and engage students' discussion.

Many examples of LMSs are Moodle, Blackboard and webCT. Moodle [10] is used in this study for building the e-learning system. It is an acronym for Modular Object-oriented Dynamic Learning Environment. Moodle offers an important feature for the e-learning systems developed using it. It provides a huge amount of students' information that is very helpful for analyzing their behavior on the course.

2.3 Classification

Classification is one type of the Data Mining techniques. It is a process of identifying understandable patterns and providing the meaningful information from the given data set. It is mainly used in computer science fields such as pattern recognition, statistics, and data base management in order to

analyze a given dataset and to take each instance of it. In addition, it is used to find models that define significant data classes within the given dataset, and extract the relation between large sets of data [11].

2.3.1 Classification Procedures

Two classification types can be defined: supervised and unsupervised classifications. Supervised is defined as processes that enable the user to select a training dataset and perform the classification algorithm on it, and then creates a model that can measure the performance and accuracy of test dataset. On the other hand, unsupervised classification outcomes are based on the software analysis of the elements, without the user defining sample classes. The computer process techniques to determine which items are related, and it must belong to actual features in order to group them into classes [11]. In this research, we rely on supervised classification which consists of the following steps [12];

2.3.1.1 Data Collection and Feature Extraction

Pre-processing operation is the first step performed on raw data collections. In feature extraction, it is better to discard the samples rows that have no values, and the attribute columns for which data is not found.

2.3.1.2 Sampling

After extracting features from the raw data, the dataset must be defined randomly into training and test dataset. The training dataset will be used to practice the model. The test dataset then will be used to evaluate the performance of the final model.

2.3.1.3 Validation

Validation is one of the most useful techniques to test different combinations of feature selection, dimensionality reduction, and learning algorithms.

2.3.1.4 Normalization

Normalization feature technique is applying in order to make comparisons between various attributes, especially, if the attributes are measured on different dimensions, and it is an essential requirement for machine learning algorithms.

2.3.2 Classification Models

Classification includes a particular outcome depend on a given input. The algorithm processes a training dataset consist of a set of attributes to providing outcomes. The algorithm tries to find out relationships between the characteristics that make it possible to predict the outcome. There are numbers of different most used learning algorithms, but the decision tree classification model is the most popular model used [11].

2.3.2.1 Decision Tree Classification Model

A decision tree is defined as a classifier in the form of data structure to analyze, recognize, and decide a particular pattern. Decision tree starts the test from the root of the tree. Then, test moves through the tree until the leaf node. Using the pruning process to stop tree splitting and decide leaf nodes with a small number of points of error or some fixed percentage of the total training set [12].

2.3.2.2 Types of Decision Tree

Decision tree has three main types that are: Classification tree analysis, Regression tree, and CART analysis "Classification and Regression Trees".

- Classification tree analysis (CTA): is an algorithm of machine learning used when the outcome of the decision for tree is a class to which the data belongs. The CTA is based on the C4.5 decision tree algorithm [12].
- Regression tree: is used when the predicted outcome is a real ordered number.
- CART analysis: CART is the abbreviation of "Classification and Regression Trees". This type of the decision tree combines the previous two types of the decision tree [14].

3 Related work

Several studies have been conducted to detect learning style of students based on their behaviors in LMS by using different techniques and approaches.

Graf et al. [15] proposed an automatic student modeling approach for identifying learning styles in LMS. This approach is developed in a generic way, based on commonly used features in LMSs including: content objects, outlines, examples, self-assessment test, exercises, and discussion forums. Data about students' behavior can be used as hints for learning style preferences depending on FSLSM. Then, the respective learning style for each student will be calculated by applying a simple rule-based mechanism on these hints.

Khribi et al. [16] intended to adopt a learner model with three components: learner's profile, learner's knowledge and learner's educational preferences. Based on a web usage mining mechanism and literature-based approach, learning styles have been identified using indication from learners' behaviors based on FSLSM. After learner model has built, they apply a hierarchical multilevel model to assign learners with common preferences and interests to the same groups, so that feedback from one learner can serve as a guideline for information delivery to the other learners within the same group.

Dung et al. [17] promoted a new method to estimate the learning style depending on the number of visits and time spent on a specific learning object. Authors developed architecture for multi-agent adaptive learning system and implemented their own web based LMS called POLCA based on this architecture. After identifying student's learning style using literature-based method, the system automatically adapts the contents to match the detected learning style.

Fasihuddin et al. [18] focused on personalization of Massive Open Online Courses (MOOCs) learning environments based on learning styles theory using FSLSM. The main goal of this study was determining the patterns that provide hints to identify students' learning styles in MOOC learning environment. Many patterns of student's interaction have monitored regarding for each learning dimension of FSLSM. After identifying learning style for students, adaptation to the learning content occurs through navigational support.

Reddy et al. [19] has collected data from engineering students using Moodle tool with ILS Questionnaire. In this research, how the student should select the different courses based on their learning styles in different levels is derived. Different classifiers are applied to frame set of rules to select suitable courses based on their learning style.

All these researches were identifying students' learning style. However, these studies depend only on students' behavior in e-learning environment and they lacked to validate their classification process. Our study focuses on obtaining behavior data of students when they are interacting with Moodle LMS and normalizing these data with ILS questionnaire results they have filled to get high precision classification of students based on their learning styles according to FSLSM. Also, students' quiz data have been used to validate the classification process.

4 Moodle E-learning System Model

In this section, the model of learning style classification depending on student's behavior in Moodle LMS will be described. Figure 1 shows the architecture of the system model.

The main components of the system model are as in the following:

- ***Moodle*:** A LMS used for developing Data Structure course to enable students to interact with the course material.
- ***LOG***: All students' activities in Moodle including students' behaviors and students' quiz results will be stored directly in LOG File.
- ***Students' Data Extraction***: it is the process of choosing the appropriate features of students that matches FSLSM dimensions from data stored in LOG file. These features includes: ***Behavior Features*** and ***Quiz Features***.
- ***ILS Questionnaire****:* Results of ILS questionnaire were collected and analyzed for using in normalization process.
- ***Normalization***: Is the process of organizing the students' behavior data collected with ILS questionnaire results, then finding relationship in order to represent them in appropriate format to create ***Behavior Classification Rules***.

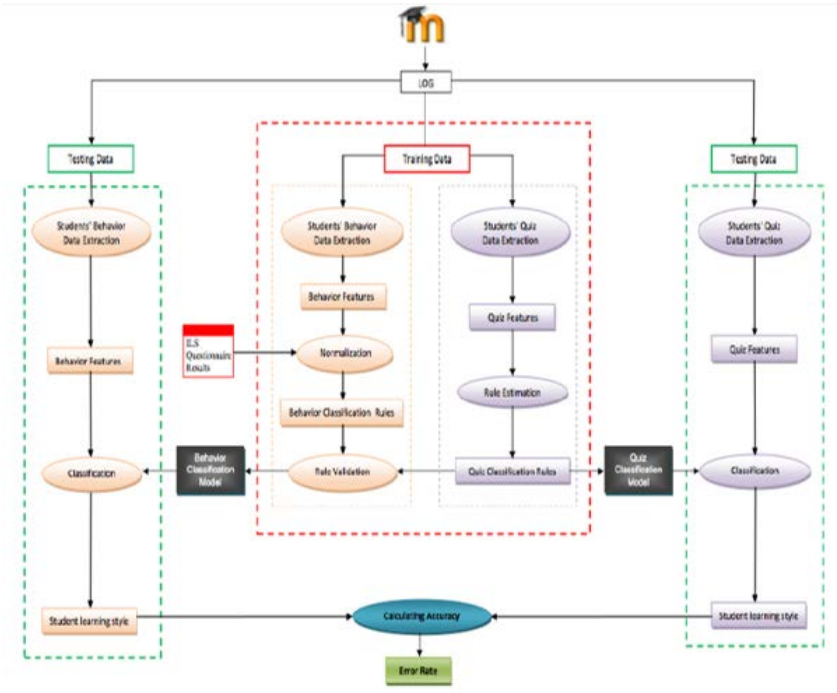

Figure 1: System Model

- ***Rule Estimation**:* Is the process of designing rules depending on the Quiz results to create ***Quiz Classification Rules***.
- ***Rule Validation**:* Is the process of validating ***Behavior Classification Rules*** with **Quiz Classification Rules.**
- ***Behavior Classification Model:*** This model is used to classify students' learning styles based on their behavior using ***Behaviors Classification Rules***.
- ***Quiz Classification Model***: This model is used to classify students' learning styles based on their quiz results using ***Quiz Classification Rules***.
- ***Classification**:* It is a process of classifying students to their learning styles.
- ***Accuracy*:** It will be calculated depending on the error rate between learning styles given by ***Behavior Classification Model*** and by ***Quiz Classification Model***.

5 System Methodology

5.1 Experimental Setup

Moodle LMS is used to build Data Structure course for undergraduate computing students at Majmaah University in Saudi Arabia. Course contents had been chosen to reflect FSLSM dimensions. An outline of the course topics was presented. Each course topic is represented in many forms; such as: text, video, simulation animation, PowerPoint slideshow. For each topic, some examples and exercises are provided. Sample code is presented to students for running and modifying. The system also contains forums for discussion. Figure 2 shows the used e-learning system for the selected course for this research, *data Structure course* provides codes, structural figures, and explanation text which serve each dimension of FSLMS learning style.

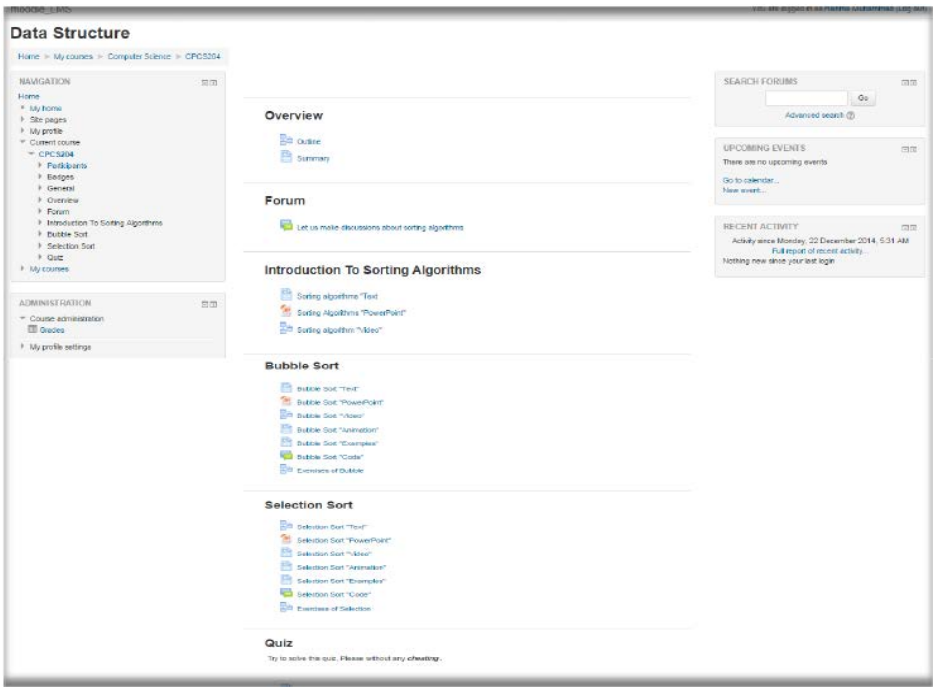

Figure 2: Screenshot of Moodle system developed for Data Structure course

At the end of the course, quiz is conducted and submitted. Quiz questions were taken from each course topic presented in the system and from all components introduced in the course that reflect FSLSM dimension. Quiz questions are in true/false form. Screenshot of the quiz is shown in Figure 3.

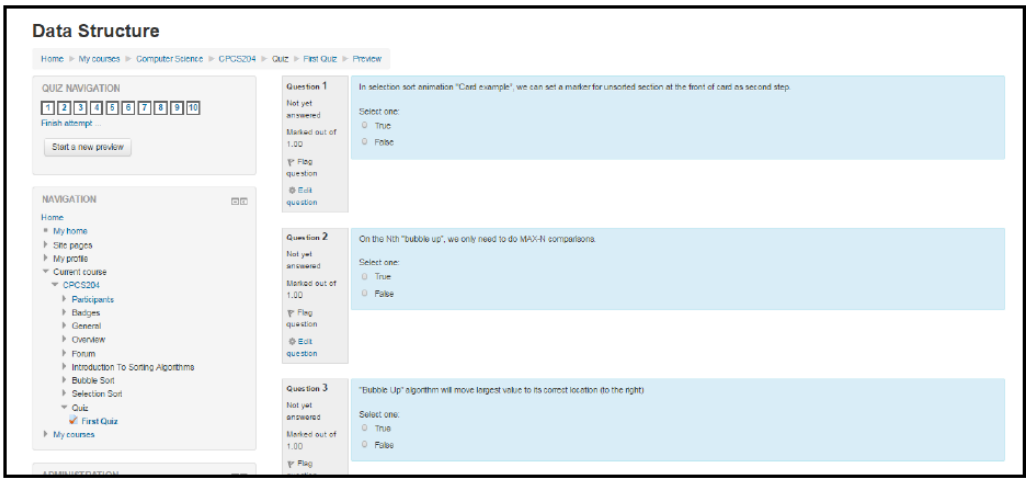

Figure 3: Screenshot of quiz presented in Moodle for Data Structure course

54 students were enrolled to the course. Each student should login to the course, browsing its contents, understanding its topics in a way she prefer. Then, the student should solve and submit the quiz. Only 35 students have logged in the course and navigate through its contents. ILS Questionnaire was provided to those 54 students to fill and submit. Only 40 students have responded. Questionnaire results were collected and analyzed for later use in student classification.

5.2 Training phase

Students' data can be acquired from LOG provided by Moodle LMS. These data includes student name, IP address, activity done, component accessed, and date and time for each activity. Students' data have been collected by tracking the students' navigation in the course, and by analyzing their answers of the quiz. Screenshot of LOG is shown in Figure 4.

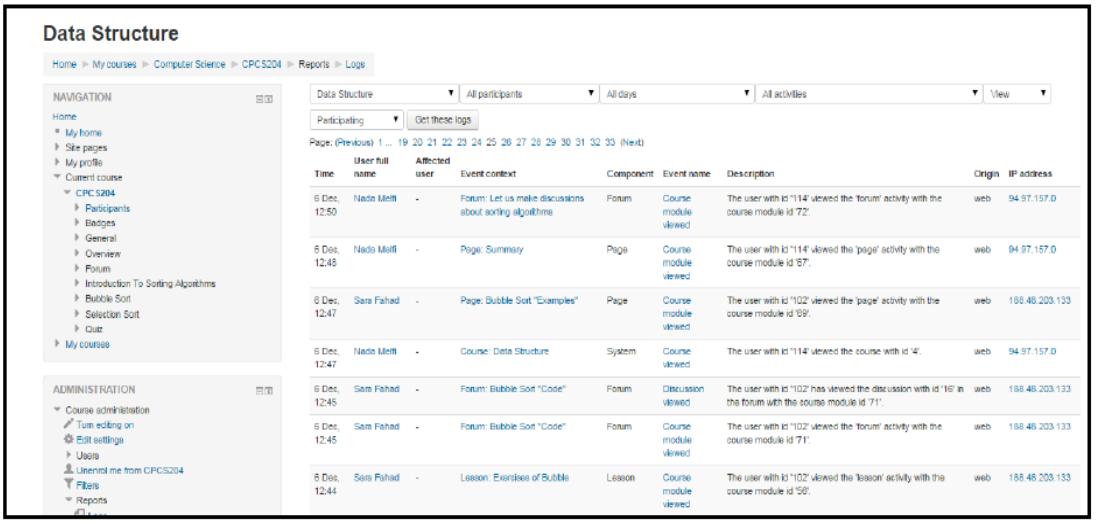

Figure 4: Screenshot of LOG provided by Moodle system

5.2.1 Students' Behavior Data

For each student, navigation activity was collected and categorized according to 10 attributes which represent the students' characteristics based on FSLSM [3]. A zero-one matrix shown in Figure 5 is used to reflect and analyze the student's behavior given from LOG.

For each student, attributes of behaviors are normalized with her questionnaire attributes to estimate the classification rules depending on the student behavior. Rules used to identifying student learning style depending on the behavior in Data Structure course are shown in Table 2.

5.2.2 5.2.2 Students' Quiz Data

For each student, quiz data is collected from LOG. Students have been classified according to FSLSM dimensions based on their solved question.

Behavior classification rules are validated using quiz data for each student. Rules results of students' classification depending on behavior data were extremely identical with results of students' quiz classification rules.

Student ID	Student Name	processing=(active/reflective)				Input= (visual/verbal)				Perception= (Sensor/intuitive)		Understanding= (Sequential/Global)	
		Forum	Sample code	Animation	Exercise	Text	Powerpoint	Vedio	Animation	Examples	Exercise	Navigation	Outlines
		post or reply=1 view or no = 0	run or modify=1 view or no = 0	visit = 1 no-visit=0	visit = 1 no-visit=0	visit = 1 no-visit=0	visit = 1 no-visit=0	visit = 1 no-visit=0	visit = 1 no-visit=0	visit = 1 no-visit=0	visit = 1 no-visit=0	global=1 linear=0	visit = 1 no-visit=0
331203961	Albandari Awadh	0	0	0	0	1	0	0	0	0	0	0	0
331202927	Amani Abdullah	0	0	0	0	0	1	0	0	0	0	1	0
331203907	Amjad Muhammad	1	0	0	0	0	1	0	0	0	0	1	1
331204951	Arwa Abdulrahman	1	0	1	1	0	1	1	1	0	1	1	1
331202235	Badriah Abdullah	1	0	0	0	0	0	1	0	0	0	0	0
331204067	Dhal Ibraheem	0	0	0	0	0	0	0	0	0	0	0	0
331203893	Futoon Sultan	0	0	0	0	0	1	0	0	0	0	0	0
331202269	Ghadeer Abdulaziz	0	0	0	0	0	0	1	0	0	0	1	0
321205673	Ghaya Abdulrahman	1	0	0	0	0	1	0	0	0	0	0	0
331203684	Hadeel Humood	0	0	0	0	0	1	0	0	0	0	0	0
321205194	Heind Medleh	1	0	1	0	0	1	1	1	0	0	1	0
331203899	Mashael Muhammad	1	0	0	0	0	0	1	0	0	0	1	1
331202931	Mashail Ya'qoub	0	0	0	0	0	0	1	0	0	0	1	0
331202508	Muneera Abdulkareem	0	0	0	0	0	0	0	0	0	0	0	0
331202251	Nada Melfi	1	0	0	0	0	1	1	0	1	0	0	0
331205033	Najah Sulaiman	1	0	0	0	0	1	1	0	0	0	1	0
321205490	Nora Fahad	0	0	0	0	0	1	1	0	0	0	1	0
331203967	Nora Sami	1	0	0	0	0	1	0	0	0	0	1	0
331202259	Norah Abdulaziz	0	0	0	0	0	1	1	0	0	0	1	0
331203524	Noura Ahmad	0	0	0	0	0	1	0	0	0	0	0	0
331203961	Noura DhafAllah	1	0	0	1	0	1	0	0	0	1	1	1
331203943	Nujood Saad	1	1	1	1	0	0	1	1	1	1	0	1
331202275	Rawan Muhammad	0	0	0	0	0	0	1	0	0	0	1	0
331202267	Rawan Muhammad	1	1	1	1	0	1	1	1	1	1	1	1

Figure 5: Students' behavior attributes

Table 2: Learning style classification rules based on student's behavior

Learning Content	Learning Content Capabilities	Student Expected Behavior on Learning Content	Student Learning Style	Affected Learning Dimension
Forum	Conducting discussion between students based on certain topics	post and reply	active	Processing
		view and no-action	reflective	
Sample code	Providing source codes for algorithms contained in the subject	run and modify	active	
		view and no-action	reflective	
Text	Describing course topics in text form	visiting text	verbal	Input
		no-visit	visual	
Power Point Video Animation	Presenting learning materials in the form of pictures, videos and animations	visiting media	visual	
		no-visit	verbal	
Examples	Providing examples of the topics discussed in the class	visiting examples	sensor	Perception
		no-visit	intuitive	
On-line exercises	Providing exercises in multiple choice questions and returning the feedback immediately to students	visiting exercises	sensor	
		no-visit	intuitive	
Course outlines	Providing the content outlines of the course	viewing course outline	global	Understanding
		no-view	sequential	
Navigation	Navigation between course materials	navigating linearly	sequential	
		navigating globally	global	

5.3 Testing phase

When a student login to the system and navigate through it, the behavior data extracted from the LOG. The student's behavior will be classified based on Behavior Classification Model to obtain the learning style based on the student's navigation. Also, Student's quiz data were extracted from LOG. Quiz data will classified based on Quiz Classification Model to get the student's learning style based on the solved questions.

Learning style based on the student's behavior will compared with learning style based on the student's quiz for calculating the accuracy of matching between the two learning styles. Accuracy of matching will be discussed in details in the results section.

6 Results and Discussion

The proposed approach has been evaluated using Receiver Operating Characteristic (ROC) to measure the quality of classification results. ROC is a graphical curve plotted using the True Positive Rate (TPR) and the False Positive Rate (FPR) of the classification results [20]. For each FSLSM dimension, four TPR and FPR values have been calculated and presented in Table 3. Four ROC curves representing classification accuracy for each dimension are shown in Figure 6.

Table 3: True Positive Rate and False Positive Rate values for each learning style dimension.

True Positive and False Positive values For Each Learning Style Dimension											
Processing Dimension			Input Dimension			Perception Dimension			Understanding Dimension		
FPR	TPR	Accuracy	FPR	TPR	Accuracy	FPR	TPR	Accuracy	FPR	TPR	Accuracy
0.05	0.23	57%	0.09	0.23	63%	0.13	0.18	62%	0.09	0.32	54%
0.12	0.47	63%	0.15	0.47	72%	0.26	0.37	74%	0.19	0.53	67%
0.32	0.68	69%	0.35	0.78	79%	0.31	0.55	79%	0.36	0.78	79%
0.45	0.92	82%	0.49	0.91	83%	0.45	0.83	87%	0.48	0.91	89%

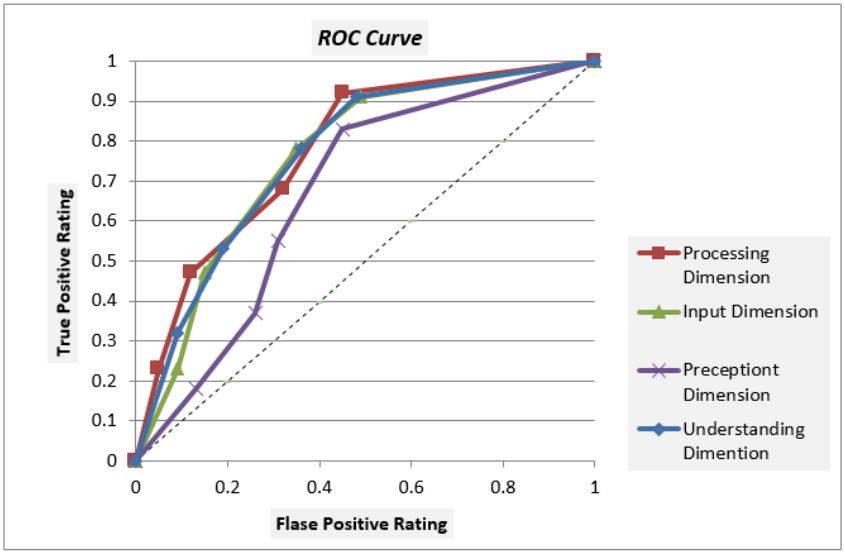

Figure 6: Four ROC curves representing classification accuracy for each dimension

Students' data have been divided into four different training and testing sets with 20%, 40%, 60%, 80% sample splitting ratio. Table 4 illustrates testing accuracy of the different sets' partitions for each

dimension of FSLSM, as shown in the table 4. The classification of 40% training data and 60% testing data gives the highest accuracy for almost the four dimensions. Using this splitting ratio, it is obvious from ROC curve that input and understanding dimensions are nearly the same and not differentiate this course type. Also, computing the area under ROC curve that represents classification quality, input, processing and understanding are very close areas. This means that based on these three dimensions, the proposed model is a good classifier for data structure students and can help instructors of this type of courses to adapt their course materials with student's type to achieve high outcomes.

Table 4: Testing accuracy of classification with various partition of training and testing data

Training Data	Testing Data	Testing Accuracy			
		Processing Dimension	Input Dimension	Perception Dimension	Understanding Dimension
20%	80%	76%	**76%**	76%	64%
40%	60%	**90%**	70%	**85%**	60%
60%	40%	67%	67%	80%	60%
80%	20%	70%	70%	80%	**70%**

7 Conclusion and Future work

In this study, we have proposed a model that classifies students depending on their behavior on Moodle course according to FSLSM. The model is experimented on 35 students enrolled in Data structure online course in Majmaah University at KSA.

The flexibility of Moodle allow instructor to track the students behavior during the course and within the quiz. Student behavior data extracted from Moodle log are normalized with ILS questionnaire to reach the final learning style. Comparing the final learning styles of each student with the results of quiz was used for validation. We have found that the accuracy of classification results is satisfactory with minimum rate of errors.

This study gives hints to the educators to format the course contents in an appropriate form matching the students' learning style to get best performance of learning process.

For the future work, we will propose a dynamic system that adapts its contents to match the learning style of student and responds immediately to her needs. Also, it is recommended to test other learning styles dimensions that may more suits computing study.

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Opinion Mining Using Sequence Labelling

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ABSTRACT

Opinion mining aims to determine the attitude of a person by identifying and extracting subjective information. The attitude is the judgement, evaluation or emotional state of the person towards a product, or service or a person. An essential task in opinion mining is to classify the polarity of a review at the document, sentence, or feature level whether the expressed opinion is positive, negative or neutral. The main objective of this research work is to formulate opinion mining task as sequence labelling and to build the models for classifying the opinion about the product Kingston Pen drive review as positive or negative. The performances are evaluated and the comparative results are analyzed and reported.

Keywords: Conditional Random Fields; Classification; Opinion mining; Prediction; Sequence labeling; Training.

1 Introduction

Social network analysis has emerged as a key technique in modern sociology and has become a popular topic of study in areas like Business and Economics, Geography, Information science, Organizational studies, social psychology, Sociolinguistics. For example, SNA has been used in epidemiology to understand the pattern of human contacts that cause the spread of diseases in a population. SNA can be used as a tool for market analysis based on opinions about products or brand to market products and services. SNA can also be an effective tool for mass surveillance. For example to determine whether or not a particular individual have criminal tendencies.

Opinion Mining or Sentiment analysis involves construction of a system to explore user's opinions made in blog posts, comments, reviews or tweets, about the product, policy or a topic. Nowadays, the exponential increase in the Internet usage and exchange of user's opinion is the inspiration for Opinion Mining. The Web is a huge repository of prearranged and unstructured data. The analysis of this data to extract the user's opinion and sentiment is a challenging task.

Opinion mining is important for businesses and organizations to know the opinions on their products, competitor products and services. It is very helpful for a company to automatically extract consumer intents from public forums like Blogs, review sites etc., which enable them to spend less expenditure on their market research activities. They can also find comparative opinions in these forums for related products or services. Opinion mining is also important for individuals in finding peers opinion when purchasing a product or subscribing to a service. Opinion mining helps to creates awareness among individuals about the product and features effectiveness and drawbacks.

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Using opinion mining, a review can be evaluated at various levels like document level, sentence level and feature level. In document level evaluation, whole review is classified into either positive or negative depending upon the opinion expressed in that review. When review is evaluated at sentence level, each sentence in a review is classified into either positive or negative. Whereas feature level or feature based opinion mining gives outline which feature of product is liked or disliked by reviewer.

Various techniques and methodologies have been developed to classify opinions. A lot of research works have been carried out in opinion mining. Based on the study of various literatures available on opinion mining a brief report is presented below.

Harb et al. [7] used two sets of seed words with positive and negative semantic orientations to perform blog classification. Google search engine was used to create association rules. Total number of positive and negative adjectives was counted in a document to classify the documents. Authors achieved 0.717 F1 score identifying positive documents and 0.622 F1 score identifying negative documents.

Taboada et al. [8] executed movie review dataset for lexicon-based method to perform sentiment classification. For classification positive and negative words dictionaries were used and semantic orientation calculator (SO-CAL) was built that incorporate intensifiers and negation words. This approach achieved 59.6% to 76.4% accuracy on 1900 documents.

An unsupervised learning algorithm was proposed by Turney et al. [9], used semantic orientation of phrases with adjectives/adverbs for review classification. The approach first extracts phrases with adjectives/adverbs; the phrase's semantic orientation was estimated using PMI-IR depending on average semantic orientation of phrases, the review is either recommended Thumbs up or not recommended Thumbs down. Experiment used 410 reviews on various topics leading to an average accuracy of 74%.

Turney et al. [10] used "Poor" and "Excellent" seed words to calculate the semantic orientation for the movie review domain, point wise mutual information method is used to calculate the semantic orientation. The sentiment orientation of a document was calculated as the average semantic orientation of all such phrases. 66% accuracy was achieved for the movie review domain.

Valarmathi et al. [11] analysed a method to create exclusive lists from a document's extracted words. Corpus of words created after exclude list was based on Singular Value Decomposition (SVD) scores. Classification and Regression Trees (CART) and Bayes Net with 10 fold cross validation determined classification accuracy as 76% and 78.667% respectively.

Kabinsingha et al [12] considered movie ratings. Data mining was applied to movie classification. Movies are rated into PG, PG-13 and R in the prototype. The 240 prototype movies from IMDb were used. Data was divided into testing and training set with four fold cross validation. Among various movie attributes like actors, actress, directors, budget, genre and producers, total number of selected attributes was 8 depending on movie genres and words used in movies corresponding to a decision used by most film rating organizations. The prototype was based on the Weka used decision tree (J48). Experiments achieved 80% to 88% precision for all tested rating.

Nasukawa and Yi [13] illustrated an approach to extract sentiments from sentences that contain opinions for specific subjects from a document, instead of classifying the whole document into positive or negative. Authors first identified sentiment expressions in different texts, the polarity and strength of

the expressions, and whether the expressions indicate a positive or negative opinion towards a subject. Author used a particular subject of interest and manually defined a sentiment lexicon for identification. The prototype system achieved high precision of 75% to 95% correctness depending on the data. The test was performed on different web pages and news articles.

In this research work a new approach based on sequence labelling for opinion mining is proposed wherein POS tags and opinion tags are used for generating the predictive model.

The rest of the paper is organized as follows; Section II discusses about opinion mining using sequence labeling. Section III presents Conditional Random Fields. Section IV describes experimental results. Finally, Section V gives conclusion and scope for future work.

2 Opinion Mining using Sequence Labeling

Sequence labeling is the simplest subclass of structured prediction problems. In sequence labeling, the most likely one among all the possible label sequences is predicted for a given input. Although sequence labeling is the simplest subclass, a lot of real-world tasks are modeled as problems of this simplest subclass. Many models have been proposed for sequence labeling tasks, such as Hidden Markov Models (HMM), Conditional Random Fields (CRF), Max-Margin Markov Networks and others. These models have been applied to lots of practical tasks in natural language processing (NLP), bioinformatics, speech recognition, and so on. And they have shown great success in recent years. In real-world tasks, it is often needed to cascade multiple predictions. A cascade of predictions here means the situation in which some of predictions are made based upon the results of other predictions.

In opinion mining using sequence labeling approach, conditional random fields are used for learning the prediction model. Conditional random fields is a class of statistical modelling method often applied in pattern recognition and machine learning, where they are used for structured prediction. This can be particularly important for opinion mining on product reviews. CRF is used to encode known relationships between reviews opinion and construct consistent interpretation of the reviews. In this approach, conditional random fields predict the sequences of labels for a given input sequences. Here, the reviews are considered as input sequences and POS tags and opinion tags are used as output labels. CST (Center for SprogTeknologi) online tagger is used for performing POS tagging and opinion tagging is done manually. The essentials tasks of POS tagging and Opinion Tagging are described below.

2.1 POS Tagging

Part-of-Speech (POS) tagging is the process of assigning part-of-speech tags to words in a review. A part-of-speech tag is a grammatical category such as verbs, nouns, adjectives, adverbs, and so on. POS tagging is necessary to determine the opinion words. It can be done manually or with the help of POS tagger. In this research work, collected reviews are given as an input to the POS tagger that tags all the words in the review. CST's tagger is used to tag the words in the reviews. CST's tagger is an online tool for POS tagging. CST's tagger is one of the first and most widely used English pos tagger, employs rule-based algorithms. In CST's tagger the following processes are used for tagging the reviews.

Segmentation: Each review is segmented into lines.

Tokenisation: CST's tokeniser segments each line into words, numbers and punctuations.

POS-Tagging: The POS-tagger automatically assigns word class information to each word in a review, whether it is a noun, a verb, etc.

Example of POS tagging is given below.

Input Review: ***the kingston pen drive speed is good***

Tagged Output: ***the*/DT *kingston*/JJ *pen*/NN *drive*/NN *speed*/NN *is*/VBZ good/JJ**

Here, each word gets a tag of POS such as NN (noun word), JJ (adjective word) etc.

2.2 Opinion Tagging

Here for each review opinion tags are assigned. The goal is to extract product entities from reviews which also include the opinion polarities. Opinion tags consist of product polarities and its entities. The product entities are divided into four categories components, functions, features and opinions.

In opinion tagging, there are three types of tags to define each word: entity tag, position tag and opinion tag. The category name of a product entity is used as the entity tag. For a word which is not an entity, tag 'B' is used to represent it. An entity can be a single word or a phrase. For the phrase entity, position is assigned to each word in the phrase. Any word of a phrase has three possible positions: the beginning of the phrase, the middle of the phrase and the end of phrase. The tags 'Feature-B', 'Feature-M' and 'Feature-E' are used to indicate the three positions respectively. For "opinion" entities, tags 'P' and 'N' are used to represent positive opinion and negative opinion respectively. These tags are called opinion tags. Thus with all of above defined tags, opinion tagging is performed for the reviews in order to prepare training dataset.

Opinion tagging for a sample review is given below:

The(B) speed(Featue-B) is(B) good(Opinion-P) and(B) its(B) ease(Feature-B) of(Feature-M) use (Feature-E) is(B) satisfying(Opinion-P).

In this review, 'speed' and 'ease of use' are both features of the pen drive and 'ease of use' is a phrase, so 'Feature-B', 'Feature-M' and 'Feature-E' are added to specify the position of each word in the phrase. 'Good' is a positive opinion expressed on the feature 'speed' and so the tag 'Opinion-P' is assigned. For all other words which do not belong to any categories of entity, the tag 'B' are assigned. In this manner, the task of opining tagging is done manually in order to transform the opinion mining task as sequence labeling task.

The modeling of opinion classification includes tagging the reviews, training the CRF model and evaluating the model based on the test data. The various stages of the proposed implementation are described in section 4.

3 Conditional Random Fields

Conditional Random Fields (CRF) are a probabilistic framework for labelling and segmenting sequential data, based on conditional probability. CRFs define conditional probability distributions p(Y/X) of label sequences Y given observations sequences X. Conditional models are used to label a novel observation sequence x* by selecting the label sequence y* that maximizes the conditional probability $p(y^*|x^*)$. For the input sequence x = x1.. xn and the label sequence y = y1 .. yn, a CRF is specified by local feature vector f and a corresponding weight vector λ. Each local feature f is either a state feature s(yi, x, i) of the

label at position i or a transition feature t (yi-1,yi,x,i) of the observation sequence x and the labels at positions i and i −1 in the label sequence. The probability of a particular label sequence y given observation sequence x is the normalized product of potential functions, of the form

$$e^{\sum_j \lambda_j t_j(y_{i-1}, y_i, x, i) + \sum_k \mu_k s_k(y_i, x, i)}$$

Typically, features depend on the inputs around the given position and may also depend on global properties of the input. The CRF's global feature vector for input sequence x and label sequence y is given by

$$F(y, x) = \sum_{i=1}^{n} f_j(y_{i-1}, y_i, x_i, i)$$

where i ranges over input positions where each $f_j(y_i\text{-}1, y_i, x, i)$ is either a state function $s(y_i\text{-}1, y_i, x, i)$ or a transition function $t(y_i\text{-}1, y_i, x, i)$. Any positive conditional distribution p(Y/X) that obeys the Markov property

$$p(Y_i / \{Y_j\}_{j \neq i}, X) = p(Y_i / Y_{i-1}, Y_{i-1}, X)$$

can be written as the probability of a label sequence y, given an observation sequence x.

$$P(y|x, \lambda) = \left(\frac{1}{Z(x)}\right) e^{\sum \lambda_j F_j(y, x)}$$

where Z(X) is a normalization factor and is given by

$$Z_\lambda(X) = \sum_y \exp(\lambda F(y, x))$$

CRF training is performed by maximizing the log-likelihood L(λ) of a given training set T = { (x_i, y_i) } i=1,..n. For a CRF, the log likelihood is given by

$$L(\lambda) = \sum_k \log P_\lambda(y_k / x_k)$$

$$L(\lambda) = \sum_k [\lambda F(y_k, x_k) - \log Z_\lambda(x_k)]$$

The maximum likelihood parameters λ are computed using an iterative technique such as iterative scaling or gradient-based methods.

4 Experiments and Results

Two independent experiments, one based on sequence labelling and the other based on classification approach, have been carried out for implementing opinion mining. Tweets about product reviews are collected manually and the training datasets are developed. In classification based opinion mining, word features are used for preparing the training dataset whereas in sequence labelling approach, POS tags and opinion tags are used. Classification algorithms such as Naïve Bayes, Maximum Entropy, and Decision Tree are employed to build classification based opinion prediction models.

4.1 Data Collection

The tweets or reviews about Kingston pen drive are collected from amazon.com. Both positive and negative reviews are collected separately by crawling raw review data. The meaningful reviews are collected from the HTML pages of the product related web pages. A total of 85 positive reviews and 85 negative reviews have been collected and used for further processing.

4.2 Classification Based Opinion Mining

For this experiment, the reviews are tokenized and the white spaces are removed during preprocessing. A dictionary is created with all the words in the reviews. Dictionary is also known as associative arrays or hash table. All the words in the reviews are considered as features. This method of feature extraction is word feature method. Then finally the opinion prediction models are learnt using naive bayes, maximum entropy and decision tree through implementing algorithms in Python integrated with NLTK. The performance of the classifiers is evaluated and the results are analyzed. The results of classifiers in terms of predictive accuracy, precision, recall and F-score are shown in Table 1 and depicted in Figure1.

Table 1: Evaluation measures of classification

Classifier/ Evaulation Criteria	Precision	Recall	F-score	Accuracy (%)
NB	0.67	0.92	0.78	73
ME	1.0	0.58	0.73	79
DT	0.75	0.91	0.83	81

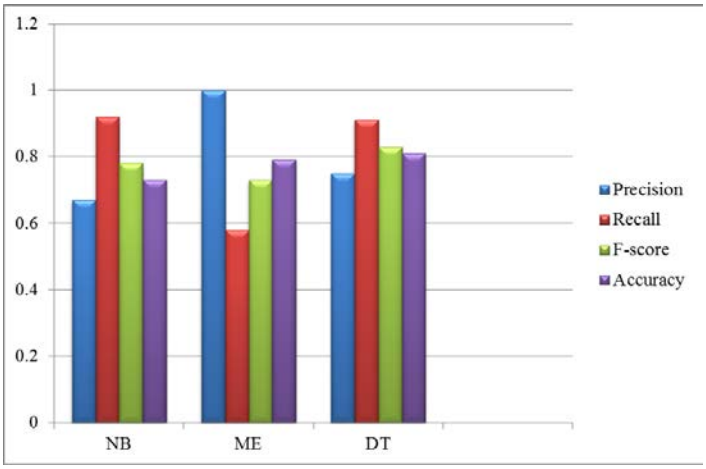

Figure 1: Comparison of classifiers

4.3 Sequence Labeling Based Opinion Mining

The second experiment is implemented using CRF++ under Linux operating system. For all the product reviews POS tagging and opinion tagging are done as described in section 2. In CRF++ the training file and the test file must be in column format. Training and test file consists of multiple tokens. A token consist of multiple columns. Each token must be represented in one line, with the column separated by white space. The training and test dataset are prepared in three column format as required by CRF++.

The first column contains words of reviews. The second column contains POS tags and the third column is opinion tags. Each review is separated by a blank line. The three column format of the training dataset is shown below.

Tweets	POS Tags	Opinion Tags
I	PRP	B
Like	IN	Opinion-P
That	IN	B
It	PRP	B
Is	VBZ	B
Small	JJ	Feature-B
And	CC	B
Compact	JJ	Feature-B
.	.	B

The model is created in CRF++ by using the template. The template file helps to extract the features from the reviews, POS tags and opinion tags. Based on the training file, the template creates a model by extracting features. The training dataset are given as an input to generate a model. In order to evaluate the CRF based opinion prediction model, the test dataset is prepared in three column format similar to training dataset. The CRF++ generates opinion tags for the reviews in test dataset and the predicted output will be displayed in fouth column. The evaluation measures of sequence labeling based opinion prediction model are shown in Table 2. The result of CRF++ is shown in Figure2.

Table 2: Results of CRF

Classifier/ Evaluation Criteria	Accuracy (%)	Precision	Recall	F-Score
CRF	**0.890**	**0.896**	**0.886**	**0.891**

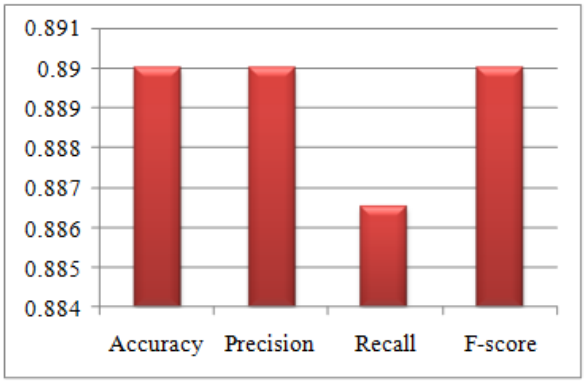

Figure2. Evaluation measures of CRF

4.4 Comparative Analysis

The comparative analysis of two experiments has been carried out and the comparative results indicate that the performance of the model based on conditional random field is better when compared to naïve bayes, maximum entropy and decision tree. Comparative results are summarized in Table 3 and depicted in Figure3.

Table 3: Comparative Results of sequence labeling and classification approaches

Classifier/ Accuracy	NB	ME	DT	CRF
Accuracy (%)	73	79	81	89
Precision	0.67	1.0	0.75	0.89
Recall	0.92	0.58	0.91	0.88
F-score	0.78	0.73	0.83	0.89

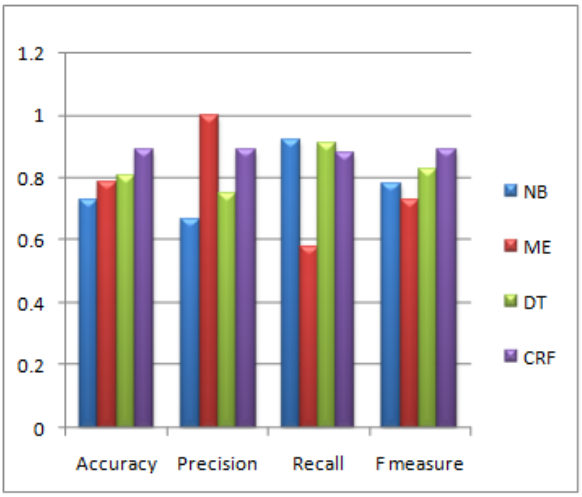

Figure3: Comparison of sequence labeling and classification approaches

From the comparative analysis, it is observed that the sequence labeling model show better accuracy and efficient in terms of precision, recall and F-score. Predictive accuracy plays vital role in real time predictions. For opinion prediction task, the comparative results shows that the sequence labeling based opinion mining approach is more supportive for predicting the review as positive or negative when compared to the classification based approach.

5 Conclusion and Future Work

This paper describes the application of sequence labeling approach to opinion prediction task and compares the results with common classification approach. The sequence labeling approach for opinion classification is implemented in CRF++ for conditional random fields. The implementation of classification based opinion mining is carried out in python language with NLTK library. Various classifiers naïve bayes, maximum entropy and decision tree have been used for building the classifiers. The performances are evaluated based on accuracy, precision, recall and F measure. It is concluded that the sequence labeling approach out performs well when compared to normal classification approach for opinion mining. In future work opinion of the product can be extended to also predict the neutral opinion of the reviews.

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Cognitive Assessment Concern and Learning Outcomes of Selected Under-Graduate Students at MLRIT-Hyderabad

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ABSTRACT

This study investigated the level of Cognitive Assessment Concern of selected undergraduate students. It also sought to find out whether CAC of students vary by ability (performance) levels and sex. A total of 246 purposively selected undergraduate students completed the 32-items Cognitive Assessment Concern Scale. Data were analyzed using contingency table and t-assessment. Results showed that students CAC was generally low. It was also discovered that CAC negatively affects performance levels; the higher the level of students' CAC, the lower the level of students learning outcome and vice-versa. However, sex differences do not lead to Corresponding differences in CAC and performance levels.

Keywords: Assessment Concern, Cognitive assessment, Learning Outcomes, student's performance.

1 Introduction

Successful learning in school subjects/courses is popularly measured by the level of students' performance in cognitive assessments. This performance is expressed in terms of student's Cumulative Grade Point Average (CGPA). It is commonly advised that teachers should give series of opportunities to learners to express their true abilities by administering series of assessments or any other assessment technique rather than a one-short version of either assessment or examination. In doing this however, a number of students experience some disruptions in their physical or emotional state.

The disruption in the individual „ creates conce
described by Olatoye (2007) is „an emotional component of human beings that manifests itself in life endeavours in form of worry and restlessness". Olatoye posited further that when this condition manifests during assessmenting session, it is referred to as assessment concern.

Research into the prevalence, and impact of assessment concern began in Yale University in the United State of America (Hembree, 1988) when students were asked to respond to a Assessment Concern Questionnaire constructed by Sarason and Mandler (1952). From the outcome of the analyses of the assessment concern data collected, students were categorized as being „ high- or low-assessment-anxious. Those found to be low-assessment-anxious did better than the high-assessment-anxious in a assessment given during an experiment where block design was employed.

Research interest on Cognitive Assessment Concern (CAC) became popular after the pioneer effort of Sarason and Mandler. Most of these researches found two distinct aspects of CAC.

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These two are what Liebert and Morris 1967) termed „worry' (any cognitive expression of concern about one‟s own performance) and 'emotionality' (autonomic reaction to the assessment situation) (Hembree, 1988; p.48). The work of Liebert and Morris shifted CAC theory towards a cognitive orientation. Thus, Wine (1971) propounded „Attentional theory‟ to describe how CAC impedes performance in cognitive assessments. The theory states that „assessment anxious persons divide their attention between task-relevant activities and preoccupations with worry, self-criticism, and somatic concerns. With less attention available for task-directed efforts, their performance is depressed‟. Many other researches confirmed the two- factor structure for CAC for quite some time (Sarason, 1978; Spielberger, Gonzalez, et. Al.,1980; Ware, Gallasi & Dew, 1990 and Ferando, Varea & Lorenzo, 1999).

Further research on the construct showed that TA could be multidimensional in nature. For instance, Furlan and Cassady (2009) reported that Valero Aguayo (1999) produced Assessment Concern Questionnaire with four subscales. These were „ □ behavioral, c
anxious situations. Furlan and Cassady stated further that three-factor model of CAC were arrived at by Ferrando, Varea & Lorenzo (1999).

These are worry, emotionality and facilitating concern. The third factor on the Performance and Concern Questionnaire by Ferrando et. al. is indicative of the notion that there is a measure of concern required for success in any given task. This will arouse the determination to succeed in the individual.

CAC causes poor performance in cognitive tasks (Cassady, 2004; Cassady, Mohammed & Mathieu, 2004 and Olatoye, 2007). It was found to have correlated negatively with performance scores in cognitive assessments (Spielberger 1972; Adigwe, 1997 and Zoller & Ben-Chain, 2007).

Findings from literature also revealed that CAC level is, to a large extent, dependent on the type of assessment or examination administered. Where the preferred item format is used to conduct assessments, students demonstrate low CAC level and this in turn leads to high score in cognitive assessments Olatoye (2007).

Looking at the influence of students‟ sex on CAC scores, most literature reviewed reported that female students have consistently showed high CAC in most cognitive assessment situation (Hembree, 1988; Razor and Razor, 1998; Olatoye and Afuwape, 2003). However, Jerrel, Cassady and Johnson (2002) reported that there was gender differences in TA, but the differences were not related to performance on examinations. In the same vein, Olatoye (2007) reported that there was no significant difference in CAC level of male and female students.

Hembree (1988) conducted a meta-analysis of researches on CAC. He posited that CAC could be caused by series of factors. These include ability level, sex, school grade level, Ethnicity, birth order and school environment. He also reported that „ □CAC was grea
with high ability. He stated further that CAC was Greater for low-ability than average-ability students with the same proportion for which it was higher between average-ability and high-ability students. The questions now are that „does CAC level reported for the various ability levels of students by different researchers remained Unaltered? ‟ is there any difference between CAC level of male and female students? How is CAC level related to students‟ performance in their study?

The objectives of the present study were to:

i. investigate the CAC level of students
ii. Find out the difference in the CAC level of undergraduate students by ability Levels
iii. Examine gender differences in CAC levels of undergraduate students

Arising from the three objectives listed, one research question and two null hypotheses were raised as listed below:

Research Question1: What is the level of Cognitive Assessment Concern (CAC) of the students?

Hypotheses 1: There is no significant difference in the academic performance of students with high and low CAC.

Hypothesis 2: There is no significant difference in the CAC of male and female students.

2 Methods

A total of 248 undergraduate Education students were purposively selected to complete the Cognitive Assessment Concern Scale (Furlan, Cassady and Perez, 2009). The students were those in 300 level of Education/Economics program.

They were purposively selected because of the ease with which their Cumulative Grade Point average (CGPA) could be obtained from the database of the software that the MLRIT College is using to process students‟ results (Ife Students Information Service - ISIS).

The sample consisted of 177 males and 136 females with an average age of 21.07 years. They all responded to the 37 items on the Cognitive Assessment Concern Scale (CACS). The CACS is a 36-item instrument developed by Cassady and Johnson (2002). The scale has „ □psychometric evidence identifying " it „ Assessment Concern □". There were factor and reliability analyses were reduced to 22 items. Furlan et.al. (2009) reported that the CACS has an internal consistency reliability coefficient of 0.91 and assessment-reassessment reliability coefficients ranging between 0.86 and 0.95 over repeated administrations. The response format on the CACS is a four-point Likert-type scale from "Always" to "Never". The score range obtainable by any respondent to the CACS falls between 37 and 106. Anyone whose Cognitive Assessment Concern (CAC) score ranges between 27 and 68 has CAC and anyone whose CAC score ranges between 79 and 106 has high CAC. Only 92 students consisting of 87 males and 35 females (with an average age of 22 years) completed all the items on the CACS and only the 82 cases were involved in data analyses. Data were analysed using the Statistical Products and Service Solutions (SPSS).

3 Results

Assessment Concern Level of Students

The level of assessment concern of the selected students was obtained through the responses of 92 students to the CACS. The mean CACS score of the sample was 63.33. The minimum CAC was 29 while the maximum CAC was 89. Incidentally, the highest CAC score belonged to a male while the lowest CAC was recorded for a female student. Both students with the lowest and the highest CAC had a CGPA of 3.00. Thus, there may not be enough basis for anyone to infer that CAC influences performance.

Hypotheses 1: There is no significant difference in the CAC level of students belonging to different ability levels. The performances of the selected students which are expressed in terms of CGPA were subjected

to t-assessment. The students were grouped into two categories of „Low" and „High" CAC levels. Their CGPA was then used for the t-assessment analysis, using the CAC levels as grouping variables.

The contingency table presenting the CAC of students belonging to the different ability levels is presented below:

Table 1: Contingency Table of CAC by Performance Level

Performance Level	CAC Level		Total
	Low	High	
Pass	1 (100%)	--	18
Third Class	4 (50%)	4 (50%)	37
Second Class Lower	22 (59.46%)	15 (40.54%)	44
Second Class Upper	33 (75%)	11 (25%)	02
First Class	2 (100%)	--	92
Grand Total	**62 (67.39%)**	**30 (32.61%)**	

The information in Table 1 shows that the higher the level of students" performance, the lower the proportion of those having high CAC. This means that CAC reduces with increase in performance. This information was further subjected to t-assessment analysis so as to check whether the difference in the mean CAC score of students in the „Low" and „High" CAC groups was significant or not significant. The result of the t-assessment is presented in Table 2.

Table 2: t-assessment result of students performance and CAC scores

TA Score	N	Mean CGPA	Std. Dev.	t_{cal}
	t_{tab}			
Low	62	3.50	0.74	1.71
High	30	3.23	0.67	1.70

Note: P<0.05: Result Significant.

From Table 1, the mean CGPA of those with „low" CAC was 3.50 (which falls within the range of Second Class Upper Division) while those belonging to the „high" CAC group have a mean CAC of 3.23 (which falls within the range of Second Class Lower Division). The performance of students with high CAC was poorer than those belonging to the Low CAC level. In confirmation of a significant difference in the performance of students in the two CAC groups, the t-assessment yielded a significant difference between the two groups (t [df=29] = 1.71; $p<0.05$). This means that CAC level affects students" undergraduate students performance negatively. The higher the level of CAC of students, the lower the level of students' academic performance. It therefore means that there is a significant difference in the CAC level of students belonging to different ability levels.

Hypothesis 2: There is no significant difference in the CAC of male and female students. The mean CAC score of male and female students were subjected to t-assessment analyses. The result is as presented in Table 2.

Table 3: t-assessment analysis of mean CAC score of male and female students

Sex	N	CAC Score	S. D.	t_{cal}	$t_{tab.}$	p
Male	67	63.78	12.14	0.58	1.71	>0.05
Female	25	62.12	12.14			

Note: P>0.05 - Result Not Significant.

The CAC score of male students (63.78) here was higher than that of female students (62.12), nonetheless, both of them fall within the low CAC range (27-68). The result of t-assessment analysis of the two group means showed no significant difference in the CAC level of male and

female students (t [df=24)=] = 0.58; p>0.05). This means that there is no significant difference in the CAC of male and female students.

4 Discussion

The level of CAC of students involved in this study was generally low. About 63% of the total sample had low CAC. It is generally believed that cognitive assessment concern has a negative relationship with performance level. Thus, it was expected that the performance of the majority of those included in this study would be high, so as to confirm the evidence in literature (Tryon, 1980; Adigwe, 1997, Olatoye, 2007 and Zoller & Ben-Chain, 2007). The result in the present study aligned with the evidence from literature that the higher the level of CAC, the lower the performance of students and vice-versa.

The relationship found between students‟ sex and CAC level was such that most of the time, female students showed higher CAC than their male counterparts (Hembree, 1986; Razor and Razor, 1998; Olatoye and Afuwape, 2003). Looking at the findings of the present study, sex differences do not necessarily lead to differences in CAC level. This finding was in agreement of the submission of Jerrel, Cassady & Johnson (2002) and Olatoye (2007) that reported that sex differences do not mean significant difference in CAC and performance in cognitive assessments.

5 Conclusion

The CAC of students have a negative relationship with the level of their performance in cognitive activities in the school. The higher the CAC level, the poorer the performance of students. In addition, sex differences do not mean differences in the level of academic performance.

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The end

Analysis of Blind Adaptive Multiuser Detection Receivers

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ABSTRACT

In this paper, blind adaptive multiuser detection with Mean Output Energy (MOE) are designed in receivers for synchronous MC-DS-CDMA systems in Rayleigh fading channels. Pre and post detection in multiuser detectors are implemented in the system to detect their effects in the outputs. On the basic of the delayed received signals, we proposed Affine Projection Algorithm-link multiuser detector (APA) and its performance is evaluated with the existing multiuser blind detectors (Normalized blind LMS and Kalman Filter). Compared to existing multiuser detectors APA-link detector outperformed the BER performance and provided a tradeoff between performance and computation cost. The analysis if further extended by implementing, decorrelating multiuser detector based receivers in SC-DS-CDMA and MC-DS-CDMA to eliminate the MAI caused by other users.

Keywords: MC-DS-CDMA, MOE, APA, BER, MAI, SC-DS-CDMA

6 Introduction

Unlike the adaptive MMSE receivers, blind adaptive interference suppression receivers do not require training sequences. It has been shown in the original work by Honig et al. [1] that, by knowing only the spreading code and the timing of the desired user, the MMSE multiuser receiver can be implemented blindly. They have developed the first blind LMS-based multiuser detection receiver in the absence of multi-path fading. It is based on the minimization of a MAI criterion by using a stochastic gradient approach. However, this method is not convenient in a time-varying environment. For this reason, other approaches have been proposed. (i) On the one hand, blind detectors based on Recursive Least Square RLS [2] and Kalman filter [3] algorithms make it possible to improve the convergence features and tracking capabilities in a dynamic environment and interferers. (ii) On the other hand, Mucchi et al. [4] have proposed a derived version of the pioneering blind LMS-based detector, which makes it possible to operate in a time-varying frequency-selective multi-path fading channels. For this purpose, they first completed channel compensation and time alignment on the signal replicas along each independent path and then combine the resulting signals before or after multiuser detection, resulting in two receiver schemes. The first scheme is called the RAKE blind adaptive multiuser detection receiver where

combining is performed after multiuser detection. The second scheme is called pre-detection combining blind adaptive multiuser detection receiver where combining is performed before multiuser detection. The pre-detection combining based receiver has the advantage of using only one detector for the combined replicas instead of one detector for each signal replica. In addition, according to [4], this yields a remarkable complexity reduction, more reliable decision variable and more robust convergence procedure.

However, the above blind adaptive multiuser detection techniques were only developed for single-carrier DS-CDMA systems. In this work, our purpose is to design blind adaptive multiuser detection receivers for synchronous MC-DS-CDMA systems in Rayleigh fading channels. For this purpose, we first reformulate the ideas presented in [4] to design two blind adaptive receivers for MC-DS-CDMA systems. Namely:

• *The first receiver provides a blind adaptive multiuser detector for each carrier followed by a post-detection combiner.*

• *The second receiver consists of a pre-detection combiner followed by a single blind adaptive multiuser detector.*

To implement them, we have proposed a blind APA-like multiuser detector [5]. The proposed detector can be seen as a generalization of the blind LMS-based detector [1], on the basis of multiple delayed input signal vectors. A comparative study is then carried out with existing blind LMS [1] and Kalman filter [3] based multiuser detectors initially developed for single-carrier DS-CDMA systems.

6.1 Receiver Structure with Post-Detection Combining

In this subsection, we propose a blind adaptive multiuser receiver with post-detection combining for synchronous MC-DS-CDMA systems in time-varying fading channels (see Figure 2.1). Thus, to retrieve the symbol sequence of the first user $d_1(n)$ we first recall the $N \times 1$ discrete-time received vector over the m^{th} carrier given as follows:

$$X_m(n) = \sqrt{P_1} d_1(n) h_m(n) c_1 + \sum_{k=2}^{K} \sqrt{P}_k d_k(n) h_m(n) c_k + \eta_m(n) \tag{1}$$

Here, as our goal is to suppress the MAI, we assume that the fading processes $\{h_m(n)\}\, m = 1, 2, \ldots, m$ are available at the receiver. Thus, channel compensation over the m^{th} carrier can be performed in the following manner:

$$\begin{aligned} \underline{X}_m(n) &= \mathrm{Re}\left(h_m^*(n) X_m(n)\right) \\ &= \sqrt{P_1} d_1(n) |h_m(n)|^2 c_1 + \sum_{k=2}^{K} \sqrt{P_k} d_k(n) |h_m(n)|^2 c_k + \mathrm{Re}\left(h_m^*(n) \eta_m(n)\right) \end{aligned} \tag{2}$$

where the multiplication with $h_m^*(n) = |h_m(n)| e^{-j\phi_m(n)}$ compensates for the phase and weights the signal amplitude by a positive time-varying factor $|h_m(n)|^2$.

After channel compensation, the resulting vector $\underline{X}_m(n)$ over the m^{th} carrier defines the input to a blind adaptive multiuser detector whose canonical linear representation for user 1 was firstly established in [1], as follows:

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Determination of Temperature Distribution in a Nuclear Fuel Element Consisting of a Sphere of Fissionable Material and a Spherical Shell of Aluminum Cladding using Finite Element Method

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ABSTRACT

This paper involves the use of Rayleigh-Ritz finite element method to determine the temperature distribution in a nuclear fuel element consisting of a sphere of fissionable material and a spherical shell of aluminum cladding. The differential equation is a one – dimensional second order differential problem. The finite solutions obtained when compared with the exact solutions shows that the accuracy increases as the number of elements increases with decrease in error, and this was shown graphically. It can be stated that finite element method is an accurate method for determining the temperature distribution in a nuclear fuel element consisting of a sphere of fissionable material and a spherical shell of aluminum cladding.

Keywords: Rayleigh – Ritz Finite Element method, temperature distribution, nuclear fuel, aluminum cladding.

1 Introduction

A nuclear fuel element for use in the core of a nuclear reactor is disclosed and has a composite cladding having a substrate and a metal barrier metallurgically bonded on the inside surface of the substrate so that the metal barrier forms a shield between the substrate and a nuclear fuel material held within the cladding.

A number of researchers have used finite element and other method to study temperature distribution. In recent times, the heat generation due to fission within a nuclear fuel rod is not uniform and for a cylindrical fuel rod, the heat generation is given by [1]. The fuel elements are usually long cylindrical rod or rectangular plates of uranium (or thorium) enclosed by cladding. The uranium may be in the pure metallic form, in the form of a compound such as uranium dioxide UO_2 or in the form of an alloy with another metal such as aluminum or zirconium in [2]. Reference [3] analyzed the temperatures and cooling rate that arises during welding. [4] determined temperature distribution on cutting tool in end-milling. ABACUS software based on finite element method was used to study the temperature and heat

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flux changes in a nuclear fuel rod by [5]. Reference [6] proposes to analyze in-pile fission gas release from UO2 fuel. The finite element model describes fission gas transfer from the grain interior to grain boundaries by simultaneous mechanisms of diffusive flow and boundary sweeping considering the effect of irradiation induced resolution when gas amount in grain. [7] used finite element method to determine the temperature distribution on TRISO fuel kernel. In [8] finite element is used to analyze the thermo-structural behaviour of cladding process. Reference [9] used finite element method to solve the problem of stress distribution in a cylindrical nuclear fuel element with a graphite matrix and spherical inclusions. The governing one-dimensional equation for heat transfer in the nuclear fuel element of a fissionable material and aluminum cladding is given in [10].

It is obvious that a number of researchers seem not to have analyzed the temperature distribution in a nuclear fuel element of a spherical form consisting of a sphere of fissionable material surrounded by a spherical shell of aluminum cladding. Hence, this paper using finite element analysis tends to fill this gap.

2 Methodology

2.1 Problem

Consider a nuclear fuel element of spherical form, consisting of a sphere of "fissionable material surrounded by a spherical shell of aluminum "cladding" as shown in the figure below. Nuclear fission is a source of thermal energy, which varies non-uniformly from the center of the sphere to the interface of the fuel element and the cladding. We wish to determine the temperature distribution in the nuclear fuel element and the aluminum cladding.

The governing equations for the two regions are the same, with the exception that there is no heat source term for the aluminum cladding. We have

$$-\frac{1}{r^2}\frac{d}{dr}\left(r^2 k_1 \frac{dT_1}{dr}\right) = q_1 \qquad \text{for} \qquad 0 \le r \le Rf \tag{1}$$

$$-\frac{1}{r^2}\frac{d}{dr}\left(r^2 k_2 \frac{dT_2}{dr}\right) = 0 \qquad \text{for} \qquad R_f \le r \le Rc \tag{2}$$

Where subscript 1 and 2 refer to the nuclear fuel element and cladding, respectively. The heat generation in the nuclear fuel element is assumed to be of the form

$$q_1 = q_0\left[1 + c\left(\frac{r}{R_f}\right)^2\right] \tag{3}$$

Where q_0 and c are constants depending on the nuclear material. The boundary conditions are;

$$kr^2 \frac{dT_1}{dr} = 0 \quad at \quad r = 0 \tag{4}$$

$$T_1 = T_2 \quad at \quad r = R_{f,} \quad and \quad T_2 = T_0 \quad at \quad r = R_c \tag{5}$$

Use eight linear elements to determine the finite element solution for the temperature distribution and compare the nodal temperature with the exact solution.

$$T_1 - T_0 = \frac{q_0 R_f^{\,2}}{6k_1}\left\{\left[1-\left(\frac{r}{R_f}\right)^2\right]+\frac{3}{10}c\left[1-\left(\frac{r}{R_f}\right)^4\right]\right\}+\frac{q_0 R_f^{\,2}}{3k_2}\left(1+\frac{3}{5}c\right)\left(1-\frac{R_f}{R_c}\right) \tag{6}$$

$$T_2 - T_0 = \frac{q_o R_f^{\,2}}{3k_2}\left(1+\frac{3}{5}c\right)\left(\frac{R_f}{r}-\frac{R_f}{R_c}\right) \tag{7}$$

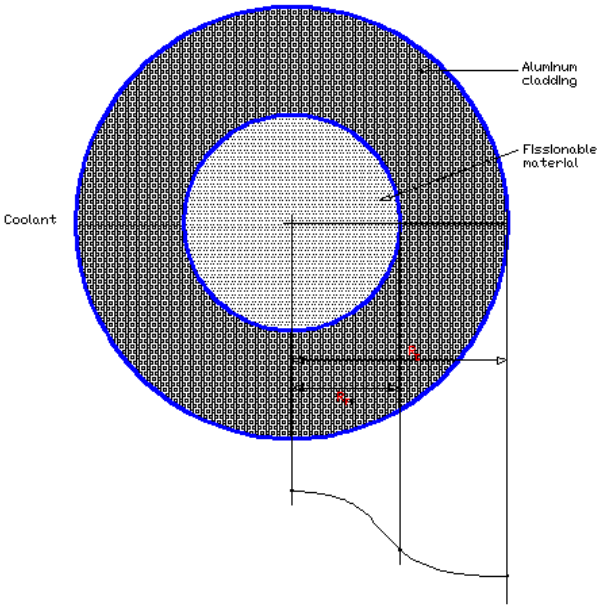

Figure 1: A nuclear fuel elements of spherical form

2.2 Solution

Using Rayleigh – Ritz Finite Element method.

Since the problem is a two in one problem, we consider both governing equations separately;

Considering the governing equation of the **fissionable material** and putting it in residual form as shown below;

$$-\frac{d}{dr}\left(r^2 k_1 \frac{dT_1}{dr}\right) = q_1 r^2 \tag{8}$$

we develop the weak form by multiplying through by the weight function (w), equate to zero and then integrate over the whole area. This gives rise to the equation below;

$$0 = 2\pi\left(\int_{r_a}^{h+r_a} \frac{dw}{dr} r^2 k_1 \frac{dT_1}{dr} - q_1 w r^2\right)dr - \left(2\pi w k_1 r^2 \frac{dT_1}{dr}\right)\Bigg|_{r_a}^{h+r_a} \tag{9}$$

The general weak form for this fissionable material is therefore written as;

$$0=\left(\int_{r_a}^{h+r_a}\frac{dw}{dr}r^2k_1\frac{dT_1}{dr}-q_1wr^2\right)dr-\left(wk_1r^2\frac{dT_1}{dr}\right)\Bigg|_{r_a}^{h+r_a} \tag{10}$$

Considering the governing equation of the **Aluminum Cladding** and putting it in residual form as shown below;

$$-\frac{d}{dr}\left(r^2k_2\frac{dT_2}{dr}\right)=0r^2 \tag{11}$$

we develop the weak form by multiplying through by the weight function (w), equate to zero and then integrate over the whole area. This gives rise to the equation below;

$$0=2\pi\left(\int_{r_a}^{h+r_a}\frac{dw}{dr}r^2k_2\frac{dT_2}{dr}\right)dr-\left(2\pi wk_2r^2\frac{dT_2}{dr}\right)\Bigg|_{r_a}^{h+r_a} \tag{12}$$

Where (r_a, $h+r_a$) is the domain of the element along its radius.

Since there is no heat loss, the weak form for the Aluminum Cladding is therefore written as;

$$0=\left(\int_{r_a}^{h+r_a}\frac{dw}{dr}r^2k_2\frac{dT_2}{dr}\right)dr-\left(wk_2r^2\frac{dT_2}{dr}\right)\Bigg|_{r_a}^{h+r_a} \tag{13}$$

The approximate solution is of the form;

$$T(r)=\sum_{j=1}^{n}T_i^e\psi_j^e(r) \tag{14}$$

Where $$\sum_{j=1}^{n}T_i^e\psi_j^e(r)=T_1^e\psi_1^e+T_2^e\psi_2^e+T_3^e\psi_3^e+\ldots+T_n^e\psi_n^e(r) \tag{15}$$

2.2.1 For the Fissionable material

Substituting equation (14) into the weak form of the fissionable material, and $\mathrm{w\ for}\ \psi\ (\mathrm{for}\ i=1\ \mathrm{to}\ 3)$, we have;

$$0=\int_{r_a}^{h+r_a}\left(r^2k_1\frac{d\psi_i}{dr}\left(\sum_{j=1}^{3}T_i^e\frac{d\psi_i}{dr}\right)-q_1\omega r^2\right)dr-\sum_{j=1}^{3}\psi_i^eQ_j^e(r) \tag{16}$$

The above can be written in the form;

$$\sum_{j=1}^{n}k_{ij}w_j^e=f_i+Q_i^e \tag{17}$$

The finite element model can therefore be represented as;