International Journal of Academic Information Systems Research (IJAISR)
ISSN: 2000-002X
Vol. 3 Issue 3, March – 2019, Pages: 37-70

Cloud Network Security Based on Biometrics Cryptography Intelligent Tutoring System

Jihan Y. Abu Elreesh, Samy S. Abu-Naser
Department of Information Systems,
Faculty of Engineering and information technology,
Al-Azhar University, Gaza

Abstract: *Intelligent Tutoring System (ITS) is becoming more famous through over the world, it impacts the view to appear obviously actually that anybody could teach at any place in whenever. Without the aid of intelligent tutoring system, the learning question's student's response can't be understood in time. Thus, it is important to create an intelligent tutoring system keeping in mind the end goal to give learning support service for students. In this thesis, the thesis presents an Intelligent Tutoring System for Learning Cloud Network Security Based on Bio-Cryptography (ITSCSBC). The elements of every said and the structure of this system present in the first place, then the program flow on that the agents in this system principle to participate with the others to propose reasonable learning pedagogical for individual student according to the estimate of students' cognitive ability level is discussed. Moreover, procedure and Process that are progressing to perform the designed functions of the agents will be discuss. The propose system (ITSCSBC) will derive adaptive learning pedagogical for an individual student to teach in a compelling and active way. This an intelligent tutoring system concentrates on the students enrolled in Advanced Topics in Information Security in the faculty of Engineering and Information Technology at Al-Azhar University in Gaza and we propose reasonable and suitable teaching pedagogical for individual student to execute adaptive teaching. During which the student will be capable to consider about the course and deal with linked issues and fixing the problems, and the results were satisfactory. The topic has been selected based on with the enormous increase in using cloud network computing which exhibits a special method to share services and distributed resources with the assist of the internet. In this way security turns into a basic issue in the cloud network security field, and cryptography is considered the best technique. In any case, the defects an encryption mechanisms can be avoided by using a cryptographic mechanism when joined with biometric encryption method is the modern world responding to network and data security problems.*

Keywords: Intelligent Tutoring, Cloud Security, Cryptography, Bio-Cryptosystem.

1. INTRODUCTION

ITSCSBC is an Intelligent Tutoring System for Learning Cloud Network Security Based on Biometrics-Cryptography. The Tutor progressively presents student with the concept of Cloud Network Security Based on Biometrics-Cryptography, and portrays most repeatedly utilized classes of Biometrics Cryptography. Cryptography is considered a fundamental and tricky part of Computer Security for the novice, for the expert, and for software designed to assist in the Cryptography. Cryptography has been in presence for a long time, from Egyptian hieroglyphics until today. Data sent over any open network must be encoded keeping in mind the end goal to make it inconceivable for every other person other than the intended receiver, and this is precisely what cryptography does. Cryptography be utilized for data that individuals or organizations need to keep private or data that ought to be accessible to just certain clients. In another meaning, cryptography is hiding of text content from unauthorized /unintended users. The encryption process is done on the sender's side when the information is to be sent through the system. At the receiver's side, the decryption process is started when the cipher text is received. In any case, the defects in algorithmic encryption mechanisms are a doorway for attackers who can decrypt the data over the network by the utilization of automated tools. A cryptographic mechanism when joined with biometric encryption method is the modern world responding to network and data security problems. Biometrics are the unique characteristics of a human being which distinguishes him/her from the others. A human being's identity can be verified by the utilization of such mechanisms. With the growing of computer and information technologies. Intelligent Tutoring Systems (ITS) are computer-based on coaching programs that apply artificial intelligence. ITS are more progressing, enabling students to promote their skills by accomplishing tasks as part of the reactive discourse hall environment. ITS can reply questions and allow customized support to the students. ITS, obverse other educational technologies, to estimate every student response in order to estimate his/her skills and knowledge. ITS can change teaching strategies; supply explanations, clarifications, demonstrations, such as, exercises and reasonable activities where you need them. Research in ITS has emphatically delighted mechanisms and systems that display adaptive support for students when fixing a problem in several domains. For the importance of Cloud Network Security, we will discuss the cloud security course in this thesis. The use of cloud computing has increased rapidly in many organizations. Cloud network computing provides many benefits in terms of the low cost and accessibility of data. Ensuring the security of cloud computing is a major factor in the cloud network computing environment, as users often store sensitive information with

cloud storage providers. But these providers may be untrusted. So the proposed ITS system for Learning Cloud Network Security Based on Biometrics Cryptography bind artificial intelligence and education, which achieves many aspirations. One is matching the special needs of each student, afford various techniques of the material and the user interaction. The system adapts its model according to student's responses. The student's privacy is achieved, including level of difficulty reached, the score obtained. The questions, which are posed to the learner are chosen randomly from the system on the level reached.

1.1 Statement of the Problem

In the recent years, the cloud network computing paradigm has emerged as an attractive solution for education realms, it brings several goodies to the m-learning ecosystem, including: virtually unlimited storage capacity, defend against data loss in case of lost or stolen devices, automatic, continuous and reliable backup of data, access to resources and collaboration on content in real-time from anywhere, reduced costs for organizations, and easy sharing of information amongst devices. Nevertheless, the outsourcing may negatively affect the level of security and privacy for any sensitive piece of data stored and administered externally. Hence University is realized a need to provide such courses which are include teaching students how to employ biometrics to secure data in a cloud network environment, there is some of the difficulties to do that in the traditional teaching: There are differences in the levels of students and their ability to learn, Some people learn slowly, with human teachers there is no sufficient time, Hesitation and fear prevents some students from asking the teacher, Referring to books on this subject take time and effort, Teachers are not available every time and everywhere, all these problems can be solved by the proposed ITS system.

1.2 Objectives

To meet the aforementioned challenges, we set the following objectives:

- This ITS system is expected to minimize the difficulties faced in Learning Cloud Network Security Based on Biometrics Cryptography (ITSCSBC) creating the suitable environment for studying.
- To develop the tutoring module.
- To evaluate the performance of the proposed system

1.3 Significance of the thesis

The proposed ITS system for Learning Cloud Network Security Based on Biometrics Cryptography (ITSCSBC) bind artificial intelligence and education, which achieves many aspirations. One is matching the special needs of each student, afford various techniques of the material and the user interaction. The system adapts its model according to student's responses. The student's privacy is achieved, including level of difficulty reached, the score obtained. The questions, which are posed to the learner are chosen randomly from the system on the level reached.

1.4 Research Methodology

These steps will be followed:

- Collect data of rules of Cloud Network Security Based on Biometrics Cryptography.
- Arrange lessons.
- Add lessons to the proposed system.
- Prepare examples for each lesson.
- Add examples to the proposed system with linked to the appropriate lesson.
- Prepare questions.
- Add questions, answers with style (True/False) or (multiple choice).
- Execute and test the system.
- Let teachers and learners use the system, and take their feedback.
- Check the system again and again depending on the feedback gained.
- Evaluate the proposed system

2. Intelligent Tutoring Systems

Intelligent Tutoring Systems employ Artificial Intelligent methodology and skills to the development of computer-based learning systems so as to build adaptive systems. An ITS focuses on education as a course of collaboration between tutor and student in which the tutor tries to demonstrate concepts to the student. Ordinarily, the procedure is controlled by the tutor, who needs to examine the behavior, the satisfaction of the student and the knowledge. The tutor has to apply and regulate the more appropriate teaching approaches at every moment. These strategies must answer a sequence of questions to guarantee that the teaching process is executed effectively. These questions are: what detail level is needful, what to explain, how and when to interrupt the student and how to correct and to detect errors [1]. One trademark of the field of education and AI is by means of intelligence to reason about learning and teaching. Representing when, how, and what to teach necessitates foundation from within a few academic disciplines, psychology, containing, education, and computer science [2]. Different tools and methods of education, psychology, and computer science are complementary and jointly supply closely comprehensive coverage of the field of AI and education as shown in Figure 1 [3].

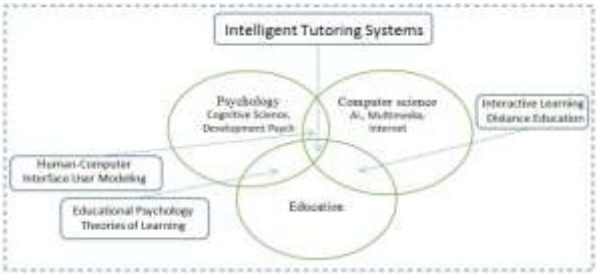


Figure 1 : The field of AI and education is grounded in three disciplines: computer science, psychology, and education

2.1 Definitions of ITS

Intelligent Tutoring Systems (ITS) are computer systems developed for enhancement and support of learning and teaching process in the domain knowledge. They aimed to gathering computer aided instruction to conventional classroom learning, individual learning and one-to-one tutoring [4]. Computers have been used in education since the sixties. Both Teachers and students require computers in all parts of education, such as in their researching, doing homework, preparing study plan, aggregating grading information, and arranging lecture notes. Presently, Modern education is hard to imagine without a computer. The usage of computers can be useful for teachers and students [5].

2.2 History of ITS

The theory of intelligent educational systems progressing from computer-aided education began in the early 1970s. In specially, with the vision of sports education, particularly postgraduate education and undergraduate. Though ITS theory starts within artificial intelligence (AI), research initially averted study in this area. The main reasons for this an avoidance or lack of knowledge about language understanding, mental models and the representation of knowledge [6].

From the point of view of the mathematical method, the loss of symbolic accounts can be added to these causes. Tentatively, some intelligent education systems, developed until now, are mentioned following.

SCHOLAR, Carbonell, Collins et al. (1969), was the earliest ITS and was developed to learn the geography of South America. Its main pedagogical strategy is to utilize Socratic dialogue in private classes, Lets both teachers and students to ask questions. The SCHOLAR program, then asks students questions and tries to diagnose misconceptions among students through the course of the dialogue [7].

WHY, Collins, Stevens et al. (1977), is an expansion of research on the nature of educational dialogues that have been implemented in SCHOLAR and uses the Socratic Dialog in a trying to teach learners the capability to generalize from experience. It attempt to examine the effects of student misconceptions [8] [9].

BUGGY, Suppes (1981), is developed to assist teachers identify misconceptions inherent in students' math problems. The teacher offers examples of erroneous math problems (buggy solutions). The systems then let the trainer to generate their own problems for the system to fix in a wrong way. Through this interaction, teachers try to realize the nature of the student's own misunderstanding [10].

SOPHIE, (SOPHisticated Instructional Environment), Brown, Burton et al. (1982), is a teacher of electronic circuit correction. The system a base rule to critique and analyze students' tries at solutions and has knowledge of problem analysis experiences. Because of the computer simulation of an incapable equipment, students must identify mistakes by taking a proper measurement [11].

WEST, Brown (1982) [12], WEST employees' training as a diagnosing student misconceptions, and an educational method while playing a game title "How the West Won", a computer simulation board game for practicing basic mathematics and drilling. WEST criticizes student decisions while playing and makes comments and suggestions to better their performance [13].

GUIDON, Clancey (1983), is an expert training program depends on an earlier medical diagnostic program, MYCIN. GUIDON utilizes a mixed dialog strategy to diagnose diseases [14].

LISP Tutor, Anderson et al. (1984) [15], learns programming language using LISP the learning theory is called ACT *. ACT * is a general theory of advanced cognition By John Anderson concentrates on memory processes. ACT * Specifies the Knowledge and procedure of the report as part of its definition of the expert problem solving model. The System functions depend on the comparison of student performance of this model Of the performance of the experts using the ”model tracking model ”, where The system responds to students' differences from the expert path to solve problems With tips directed at directing the student to the path. The teacher was LISP The first in a series of teachers developed according to the principles of ACT *. Ago In early 1980, other teachers of ACT *, including Pascal and Algebra were developed Engineering [16].

MAIS, Tennyson, Park (1987), The Minnesota Adaptive Instruction System (MAIS) Developed according to the systems approach to instructional design. And MAIS the rate at which students face topics is adjusted using a Bayesian (Predictive) Model of student progress through the curriculum. Level of difficulty in lessons they are adjusted according to the prediction of student performance based on history of performance [17].

The following systems have been developed since 1990. OGF, The Pchai, S., Inaba, A., Mitsuru, I., Toyoda, J., Mizoguchi, T., Opportunistic Group Formation - research Explore them using smart agents as individual assistants in a cooperative Learning environment. Assist agents involved in setting the team's goals as different of personal goals by providing communication guidance to the team process. Results that have not been formally studied [18].

MethodMan, Crump, Project Management Software. User-controlled exploration Adaptation vs. Adaptation Controlled by the system. Experimenting with the user Adaptive ability has shown that user-based learning is limited by the learner's judgment Lack of clarity in what the learning path should be [19].

ILEX, Cox, R., O'Donnell, M., Oberlander, J., Intelligent Labeling Explorer - Intelligent hypertext online museum repository exploration. Researchers compared the subject Exploration patterns are in two ways: with intelligent routing system, and without Orientation [20]. There are no statistically significant differences in learning to compare these [21].

ISIS, Meyer, T., Miller, T., Steuck, K., Kretschmer, M., Instruction in Scientific Surveying Skills - A simulation based learning system for beginners and seniors High school students research skills in biology and the environment. The system Gradually used learning skill-challenging modules (SIM). Two years of quasi experimental the study of efficacy design shows that the most effective stimulant than conventional Row instructions [22].

PACT, Aleven, V., Koedinger, K. R., Cross, K., Geometry instruction based on the theory of Andreson ACT-R for education [23] as well as on a set of principles for the design of Cognitive Tutors (Koedinger & Corbett, 2006) [24]. Researchers investigate the value of interpretation Requirements in solving students' geometry problem compared with a simple right answer approach. The results show that students provide reasons for their solutions Demonstrated a better understanding of engineering principles and were better in their application Knowledge when given new problems [25] [26]. The following Table 1 shows some ITS the project:

Table 1: Some ITS Projects

ITS till 1990	ITS from 1990
SCHOLAR 1979; Carbonell, Collines et al.	OGF; Thepchai, S., et al.
WHY, 1975; Collins, Steven et al.	MethodMan; Crampe Software Project Management.
SOPHIE, 1982; Brown, Burton et al.	ILEX; Cox, R., O'Donnell, M.., Oberlander, j.
BUGGY, 1981; Suppes.	ISIS; Meyer, T., Miller, T., Steuck, K.,Krestschmer, M.
LISP Tutor, 1984; Andesrson et al.	PACT;Aleven, V., Koedinger, K. R.,Cross, K.
MAIS, 1987; Tennyson, park	

We can summarize the previous historical introduction as follows, in the early 1970s, Intelligent Tutoring Systems start to develop from simple computer-aided instruction (CAI). In simple CAI the interface is static with esteem to each user. Information is presented in a lecture (or storyboard) fashion, classed into topics to form some curriculum of sorts. The student moves their way through the curriculum according to their needs, although each student is offered with punctually the same choices and information. They may ask questions either on automatically or request, to testing their understanding until now. Feedback on their response is ordinarily limited to an indication of whether their answer was wrong or right, and what the correct answer was. If any further feedback is required, such as comments on individual incorrect answers, it must be hand crafted for each question.

The problem with such systems is multiple:

First, the information they present does not target their audience. Though the student may choose parts of the curriculum they are concerned with, this is performed at a very high level, and the actual content of each topic is not changing. The system may thus expose information that the student is already customary with, asking them to slog through it in seeking of the parts that are of use. Worse, it may make assumptions about what the student knows, even though they have not covered the required part of the curriculum. The student will then want to hunt for the relevant concepts in the remainder of the material. This problem spreads to the setting of exercises. On conclusion of a topic, a simple CAI often confuses some questions so the student can show how well they have understood the material. However, the system may make invalid assumptions about what the student knows at this stage, and hence set problems that they are incapable to fix. Likewise, if the student has if the student has understood most of the content but is suffering with a special aspect, the system is ignorant of this and may not set enough/any exercises in the problem area.

Most of the content but is s suffering with a special aspect, the system is ignorant of this and may not set enough/any exercises in the problem area.

Second, the feedback on problems is of restricted use. People teach by applying the relevant skills, and so problem fixing is a serious part of teaching. However, the utility of performing the exercises is dependent on how much can be learned from mistakes made [27]. To be useful, the system wants to tell the student why the answer was wrong. In simple CAI, this is difficult, because the system has no understanding of the domain: it simply views, information and problems that have been stored by a teacher. Any additional feedback is developed from scratch for each problem.

2.3 Architecture of ITS

A classical architecture of an intelligent tutoring system consists of 4 different components [28]. The main components of an ITS as simply shown in Figure 2 are simply defined in the following.

Cognitive Module: Also, it is known as Domain Module or Expert Knowledge. A coach or tutor incorporates declarative (what), procedural (how), and metacognitive (thinking about what and how) knowledge. This component is equivalent to the Knowledge Base or Domain Module of other architectures, it represents the domain specialization of the ITS, that is the capability to fix problems within the domain [29].

Student Module: This module contains the diagnostic specialization of the ITS and generates the Student Module with all information about the individual student. An internal module representing cognitive processes (such as problem solving, calculation and information retrieval), meta-cognitive strategies (such as learning from errors) and psychological attributes (interests, learning style, and developmental level) are maintained for each learner [30].

Pedagogical Module: Also, it is known as Tutor Module. It is responsible for the instructional specialization and

provides implementations of various tutoring strategies. This module is like to its counterpart the Tutoring Module in other architectures. It utilizes a module of the learner's present comprehension to choose an efficient path through its knowledge representation to generate expert behavior by the learner. It employs various teaching methods on the basis of an evolving Student Module [31].

Communication Module: Also, it is known as User Interface Module. It implements the human-computer-interface of the ITS [32].

Expert Module: The Expert Module is considered to be the backbone of an ITS. The instructional system cannot erected without the domain knowledge [33].

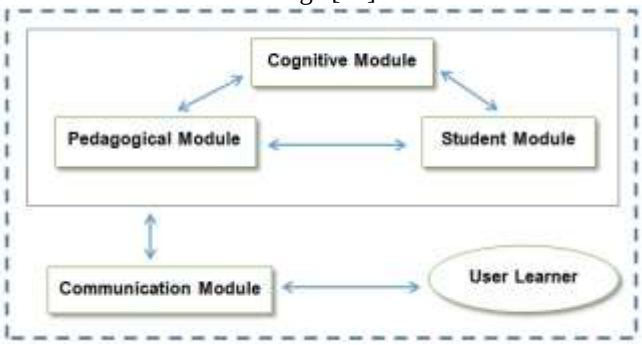


Figure 2 : The four-component architecture for ITS

2.3.1 Cognitive Module

The Cognitive Module Consists a representation of the information to be educated. It provides input into the Expert Module, it has the knowledge of which things should be educated with students. In the end it is used to provide exhaustive feedback, problem generation/selection, and as a rule for the Student Module. It represents the rules and the facts of a specific domain to be transferred to students. A cognitive generally refers to a field of study [34]. A Cognitive Module is often the first step in representing student knowledge, which may represent the same knowledge as the Cognitive Module and solve the same problems. This module generates problems, questions, answers, explanations, comments, and hints and it provides standards for examination students' performance. The cognitive model also uses to trace a student's knowledge growth across activities and dynamically updated estimates of how well the student knew each production rule. [35]. Domains differ in structure and hardness, from well-structured to ill-structured, and from simple (well defined) to complex. The Cognitive Module may have many forms, depending on the domain it represents, the knowledge representation utilized and the granularity of the information being represented, They take into three different classifications [36]:

1. **Problem-solving domains**, such as (Newtonian mechanics, mathematics problems, e.g.) some simple stats with explicit, correct solution also exists here (e.g., identify a fault in an electrical board).
2. **Analytic and unverifiable domains**, such as law and ethics. These domains do not consist measurement or wrong /right answers and experimental Verification predominantly untenable.
3. **Design domains**, such as music composition and architecture, exist at the most complex and ill-structured point. In these domains, the goals are creativity and modernity, not fixing problems.

For the well-defined and simple domains, the set of training problems is presented employing current learning strategies. Although, no formal theory finds to verify for the ill-structured and complex domains [37]. Cognitive Modules are qualitative representations of expert knowledge in a given domain. They may represent the procedures, facts, or methods that experts utilize to perfect tasks or fix problems Student knowledge is then represented as Illustrative Versions of that domain knowledge. Earliest tutors were built in well-defined domains (algebra, system maintenance, and geometry), and little were built in less well-structured domains (design, music composition, architecture, law) [38].

2.3.2 Pedagogical Module

The Pedagogical Module (also called learning strategy or Tutor Module) [39] takes information from the Cognitive and Student Module and devices tutoring strategies with actions. Pedagogic Module makes decisions linked to the chosen of suitable learning units, curriculum sequencing, learning methods, and questions through such processes, the Pedagogic Module related to the Student Module to get relevant information [40]. This module can generate the problems dynamically. It tracks the learner's progress, builds a profile of weaknesses and strengths relative to the production rules termed as knowledge-tracing. The Pedagogical Module consists of a group of specifications of what instructional materials the system should present and when and how it should present the materials. The Pedagogic Module should behave such an expert teacher who supplies timely feedback, examples, multiple views, analogies, and different levels of explanations. The system must control the student's actions, and advise the student about errors, and anticipate future actions based on inferences about the student's current activities (Woolf, 1987) [41]. The system should know how to focus on the appropriate issues and how to ask the right questions.

2.3.3 Student Module

The Student Modeling Component is a critical component of an ITS, since the student has the central role in the teaching process. Self (1990) addressed the critical necessities of Student Module [42]. The Student Module is simply about the theory of student behaviors. The Student Module evaluates each learner's performance to determine his or her knowledge, perceptual abilities, and reasoning skills. It provides the information such that what the student knows or does not know [43], any misconceptions, the student's degree of forgotten fullness and the facility of comprehension and accommodation of advices given by the

system. Briefly, the Student Module determines module the student's mental state [44]. pointed out that the Student Module must use the empirical student data, however, most of the students has handicapped in this sense and these Student Modules do not sufficiently parameterized the student responses (see Harp, Samad, & Villano, 1995) [45]. There are several paradigms for student modeling, which are briefly summarized in following.

1. Module Tracing and Bug libraries
2. Overlay Module
3. Constraint-based Modeling
4. Bayesian Net Modelling

2.3.4 Communication Module

The user Communication Module (also called learning strategy or User Interface Module) provides the means for the student to interact with the ITS, usually through a graphical user interface and sometimes through a rich simulation of the task domain the student is learning. Interface design is the area in which classical multimedia authoring tools of ITS are used the most [46]. Because it takes too much time to form an interface. The interfaces, graphics and ready texts which are generally used in instructional software and computer systems contain the areas of information input by means of a keyboard and menus. Communication Module requires three types of information to implement the dialogues. These are information about the module which form the required explanations to understand the speaker during a dialogue and the required activities to create verbal expressions, the area information which is necessary for the content of communication and the information which is necessary for the aim of communication. The Communication Module is the communicating component of the ITSs which controls the interaction between the student and the system. In both directions, it translates between the system's internal representation and an interface language that is understandable to the student [47]. Because the Communication can make or break the ITSs, no matter how 'intelligent' the internal system is, it has become customary to identify it as a distinct component of ITS own. In fact, it would be a mistake to consider it a secondary component of the IT'S for two main reasons. An ITS is only as effective as the various modules it relies on to adequately Modules expert, student and tutor knowledge and behaviors. Thus, building an ITS needs careful preparation in terms of describing the knowledge and possible behaviors of experts, students and tutors. This description needs to be done in a formal language in order that the ITS may process the information and draw inferences in order to generate feedback or instruction. Therefore a mere description is not enough. The knowledge contained in the modules should be organized and linked to an inference engine. It is through the latter's interaction with the descriptive data that tutorial feedback is generated [48].

Some researchers have replaced the word "Cognitive Module" with the word "Expert Module" in the other classifications of ITS architecture [49,50].

2.3.5 The Expert Model

The Expert Module is very similar to the Domain Knowledge Module in that it includes knowledge about the domain. But, there is one important difference. The Expert Module depicts how an expert would represent this knowledge. To solve problem environments the Expert Module is sometimes runnable, i.e. one that is able to fixing problems in the domain [51] [52] [53] and is thus often mentioned to as the problem solver. The system can examine differences among the Expert Module and the student's solution and give feedback when they vary from each other. Within the Expert module there has been much advance made in knowledge representation methods in problem-solving domains comprising basically formal systems, like physics, geometry, algebra, electricity, computer languages and theorem proving. This does not fill true for the advance made with such non-formal domains as those including those including both conceptual and perceptual knowledge, like computer-based systems supporting decision making and conceptual knowledge, like medical sciences and biological [54].

2.4 Main Characteristics of Intelligent Tutoring Systems

It is explicit that intelligent tutoring systems have a number of the major behavior and characteristics , which are related to group architectural components.

Table 2 illustrates five architectural components and their related characteristics. These characteristics would be useful for the comparison and evaluation of current ITSs, In addition drive the design of novel ITSs, it be known that behavior of ITSs and the architecture are to some constrained by assigning application domains design paradigms (e.g. geography, mathematics, programming, etc.) and (e.g. diagnostic tutors, coaches, problem solving monitors, etc.). From here, some of the characteristics might not be recorded in specific architectures [55].

Table 2: Outlines five architectural components and their related characteristics

ITS Architecture	ITS Characteristics/Behavior
Cognitive Module / Domain Module	**Intelligent tutoring systems must:** • owns system domain knowledge to make problems or solve. • existing explanation of problem solutions. • give an alternative demonstration of the same idea. • response arbitrary questions from the student

	• blend knowledge about missing concepts and common misconceptions.
Pedagogical Module / Tutoring Model	• Owns system learning aims and plans. • Provided an alternative learning strategies. • Be guided by an underlying instructional theory. • Tailor system's learning strategies with student's requires. • Allow student to attractive learning activities. • Provide contextualized, domain-related and beginning instructional activities. • Diagnose learning needs and misconceptions Intervene if the student seems to be meeting difficulty. • Bind a missing concept to a diagnosed error. • Misconception or a Incorporate. • Mixed remedial strategies to grant alternative remedial learning models. • Diagnose misconceptions and learning needs.
Student Module	• keep data about the student's skills, and knowledge (current and advancing) in the student Module. • Update student model and estimate and control student performance. • Store data on student's teaching priorities and prior learning experiences in the student Module, if the requirement. • Store data on the student's cognitive processes.
System Control	• Display helpful feedback about student input. • Adapt to the preferences and needs of the student. • Adapt to the student's level of progressing. Address all detected errors. • Reply if it cannot Intervene to handle a misconception or a missing idea. • Diagnose an error.
Communication Module / User Interface	• Increase ease of usage. • Adopt a collection of interaction processes. • Guarantee that the dialogue is adaptive and task-oriented. • Owns an effective screen design. • Blend natural interaction dialogues.

2.5 Advantages of ITS

There are many reasons to make students prefer intelligent tutoring for their learning. Some students feel unable to learn efficiently by using Traditional methods of education. Others may find their selves are more receptive to learning through intelligent tutoring. Tutoring can assist strengthen boost confidence, subject comprehension, and build important learning skills.

Tutoring gives students individualized attention that they don't obtained in a crowded classroom. This assists student who strive to keep up, as well as those who aren't braved enough. It also keeps students on track during their studying. The benefits of tutoring programs can help students develop learning and study skills that will assist set up students for success for her or his entire life. There are many advantages of intelligent tutoring [56]:

1. Unique and Individual learning experience

The student will receive an individualized learning experience she or he can't always obtained in a classroom setting. Tutors can customize the activities and lessons just for the student.

2. One-on-one attention

Tutors get to know the student's individual learning style and can adapt learning Strategy accordingly. They act as a student's own private teacher.

3. Improves academic performance

Tutoring will prepare student for exams and tests, while tutors work with students on specific problem areas. Student's grades and understanding of the subject will safely improve when working with a tutor.

4. Improves position towards education and learning

Learning will become fun for your child. With continual praise and encouragement, student will no longer feel frustrated or overwhelmed with learning.

5. Supports self-paced and self-directed learning

With tutoring, the student will educate to take the initiative her or his learning work. Student will also learn how to control the learning speed.

6. Improves confidence and self-esteem
Student's confidence and self-esteem will raise through intelligent tutoring, by providing her or him with the skills and resources she or he needs to upscale in the learning process.

7. Improves study and work habits
Through tutoring, student will learn study and work habits, she or he will use for life. These skills will assist prepare student to successfully achieve his or her aims both inside and outside of the university.

8. Positive work space
Tutoring supplies an environment free of distractions, with fewer the students and disruptions around so student is better able to concentrate on learning.

9. Encourages responsibility and independence
The student will gain the power of doing work on her or his own, without teachers help. The student will understand her or his own individual development and will teach to take responsibilities for her or his studies.

10. Assists overcome education obstacles
The student's tutor will precisely target any aspect of teaching, she or he is having disorders with, whether it's writing, reading, language, or math.

11. Motivation the freedom to ask questions
At classroom, a student may not evermore feel comfortable asking questions in front of her or his colleagues. Tutoring will assist teach student to be comfortable asking questions, small or big, without feeling self-conscious.

12. ameliorates behavioral and social skills
Intelligent tutoring services will make more positive social and behavioral adjustments, and help the student to be a better communicator, form better relationships with colleagues.

13. Rising capability to manage student's learning
The student will be more competent in her or his teaching and more effective in managing her or his education.

14. Challenges those who want it
Tutoring helps under-stimulated or bored students reach their whole potential.

15. Prepares student for work
Students heading off to work will evolve advanced study skills, learn how to make study plans, and learn excellent time management skills. There are numerous interests of tutoring in work, including buildup of present knowledge and acquire better understanding of a field of study.

2.6 Study Community

In this proposed ITSCSBC intelligent tutoring system the sample community consists of teachers, and students enrolled in Advanced Topics in Information Security in the faculty of Engineering and Information Technology at Al-Azhar University in Gaza.

3. Literature Review

In the modern day Information Technology abounds with many studies on artificial intelligence and intelligent training and we have a massive expansion of Intelligent Tutoring System, ITS has fetch much attention of the researchers. In this part of the study, the researcher reviewed what has been authorship in previous studies whether directly or indirectly. The researcher will analyze and present some of the previous studies that were obtained, which are relevant to the subject of the current study, and the previous studies were reviewed according to their significance of the current study.

- **The study of (AbuEl-Reesh and Abu-Naser, 2018) An Intelligent Tutoring System for Learning Classical Cryptography Algorithms (CCAITS).**

In this paper, the author presents an intelligent tutoring system for Learning Classical cryptography algorithms. The structure of this system and the elements of every part present in the first place, and then the program flows on which the agents in this system base to participate with the others to suggest reasonable learning pedagogical for individual student according to the evaluation of students' cognitive capability level is discussed. Moreover, the algorithm and procedure which are sophisticated to execute the designed functions of the agents was explained. The suggested system for Learning Classical cryptography algorithms was derived adaptive learning pedagogical for an individual student to learn in a compelling and effective way. This an intelligent tutoring system concentrates on the students registered in Advanced Topics in Information Security in the faculty of Engineering and Information Technology at Al-Azhar University in Gaza and the author suggest reasonable and suitable learning pedagogical for individual student to perform adaptive learning. During which the student will be able to think about the course and deal with related issues and solving the problems. An evaluation of the Learning Classical cryptography algorithms system was finished and the results were positive [57].

- **The study of (Marouf et. al., 2018) An Intelligent Tutoring System for Learning Introduction to Computer Science.**

The design of an Intelligent Tutoring System named Computer Science Course -Tutor was described in that research. Computer Science Course-Tutor was developed to teach students Computer Science Course to overcome their difficulties. Computer Science Course-Tutor is dynamically adapted at run time to the student's individual progress. A primary evaluation of Computer Science Course-Tutor was executed by a lecturer and several students. The result of the evaluation was positive and proposed that other intelligent tutoring systems should be developed in other courses. Then the researcher recommended an overall evaluation of the system to be executed next time the course is presented [58].

- **The study of (Albatish et. al., 2018). ARDUINO Tutor: An Intelligent Tutoring System for Training on ARDUINO.**

This article aims at trainees to defeat the difficulties they face when dealing with the Arduino platform by presenting the design of a desktop depend on intelligent tutoring system. The major idea of this system is a systematic introduction

into the meaning of Arduino platform. The system offers the circuit boards of Arduino that can be purchased at low cost or collected from freely-available plans; and an open-source development environment and library for writing code to control the board subject of Arduino platform. The system is adaptive with the trainee's individual advance. The system functions as a personal tutor who deals with trainees according to their levels and skills. Evaluation of the system has been applied on professional and unprofessional trainees in this area and the results were perfect [59].

- **The study of (Al-Bastami et. al., 2017). Design and Development of an Intelligent Tutoring System for C# Language**

In this paper, the authors try to help users learn the C# programming language using Intelligent Tutoring System. This ITS was developed using ITSB authoring tool to be able to help the user learn programming efficiently and make the learning procedure very pleasing. A knowledge base using ITSB authoring tool style was used to represent the user's work and to give customized feedback and support to users [60].

- **The study of (Hamed et. al., 2017). An Intelligent Tutoring System for Teaching the 7 Characteristics for Living Things.**

ITS was utilized in designing a teaching system of science for the 7th grade user in order to expound the characteristic for living things. In this article, researchers describe the design of an Intelligent Tutoring System for learning science for 7th grade to assist students know the 7 characteristics for living things smoothly. The system presented all topics of living things and generated some questions for each subject and the students should answer these questions correctly to shift to the next level. An evaluation was made for checking the teachers and students satisfaction of the ITS. The results of the evaluation appeared that the teachers and students liked the system and they said that the system is very helpful for them and for their studies [61].

- **The study of (Appleton, 2017). Introducing Intelligent Exercises to Support Web Application Programming Users.**

A prototype system was designed wing the ITS to assess user in teaching the web language Java Script [62].

- **The study of (Almurshidi et. al., 2017) Design and Development of Diabetes Intelligent Tutoring System.**

This paper illustrates the design of a desktop based intelligent tutoring system for learning diabetes to the student to overcome the hardness they face. Intelligent Tutoring Systems intended to supply customized and immediate feedback or instruction to learners. This system prop the idea of recent health strategy, skilled patient who has progressed a high level of expertise and knowledge to enable them to control and manage their own statuses. The researcher developed and designed the system using clinical medicine books, doctors, and questioners. The system assists students to mightily understand diabetes and diagnose it by explaining its kinds and offers the reasoning for each one. Evaluation of the system has shown good favorable results and positive effects [63].

- **The study of (Al-Hanjori et. al., 2017) Learning Computer Networks Using Intelligent Tutoring System.**

In this paper the researchers describe an intelligent tutoring system that assists student study computer networks. The presented ITS provides an intelligent presentation of educational content suitable for students, such as the degree of knowledge, student level, the desired level of detail, assessment, and familiarity with the course. Their Intelligent tutoring system was developed utilizing ITSB authoring tool for building ITS. A preliminary evaluation of the ITS was done by a set of students and teachers. The outcomes were acceptable [64].

- **The study of (Abdulla and Abu-Naser, 2017) An Intelligent Tutoring System for Cloud Computing.**

In this article, the researchers have designed an Intelligent Tutoring System Teaching Cloud Computing by employing ITSB authoring tool. The ITS system was developed to smooth the study of cloud computing lessons by the students, and overcome the difficulties they face. The ITS for cloud computing architecture and requirements of each part of the ITS system have been illustrated. The researchers made an evaluation of the ITS two groups of students and teachers. The results were very agreeable [65].

- **The study of (Elnajjar et. al., 2017) DSE-Tutor: An Intelligent Tutoring System for Teaching DES Information Security Algorithm.**

In this paper, the authors have designed an Intelligent Tutoring System for learning DES Information Security Algorithm by using an ITSB authoring tool. The system is Known DES-Tutor. DES-Tutor was designed to ease the study of teaching architecture cryptography and Information Security by the students. DES-Tutor requirements and of each module in the system have been clarified. The authors doing an evaluation of the DES-Tutor by a group of teachers and students and the outcomes were promising [66].

- **The study of (Aldahdooh et. al., 2017) Development and Evaluation of the Oracle Intelligent Tutoring System (OITS).**

This paper presents the development and design of intelligent tutoring system for learning Oracle. The Oracle Intelligent Tutoring System (OITS) tested the power of a new methodology to propping students in Oracle programming.

The system displays the subject of Introduction to Oracle with automatically generated problems for the students to resolve. The system is dynamically adapted at run time to the student's individual progress. An evaluation study was done to investigate the effect of utilizing the intelligent tutoring system on the performance of students, and the outcome of the evaluation was positive [67].

- **The study of (Hilles et. al., 2017) Knowledge based**

Intelligent Tutoring System for Teaching Mongo Database.

In this paper, the authors have designed a knowledge based Intelligent Tutoring System called MDB for learning Mongo Database by utilizing ITSB authoring tool. The system was developed to simplify teaching Mongo Database. MDB System architecture was outlined plainly. An evaluation of the MDB system by teachers, and students, the results were more than passable [68].

- **The study of (Akkila et. al., 2018) Rules of Tajweed the Holy Quran Intelligent Tutoring System.**

The aim of this thesis many help the Muslims face a lot of problems in reciting the Holy Quran due to the numerous rules of Tajweed and shyness of older people in making reading mistakes in front of the teacher.

To face these problems an intelligent tutoring system for learning Reciting Al-Quran "Tajweed" with Rewaya: Hafs from 'Aasem by the way of Shatebiyyah (the most communal rewaya in many countries) was presented. This system supplies direct feedback, personalized training and to the student's intendant of human teachers.

The system was examined by two groups of users, one for teachers second for students and they were required to run the system then evaluate it easily, the material and the user interface. They reported that the system results most of the problems in learning rules of Tajweed in the traditional learning and pointed that it attains adaptation upon the requirements of each student [69].

- **The study of (Weber and Prusilovsky, 2016). ELM-ART -An Interactive and Intelligent Web-Based Electronic Textbook.**

ELM –ART (ELM (Episodic Learner Model) – ART (Adaptive Remote Tutor) is a Web-based Intelligent Tutoring System (WITS) designed for learning users programming in LISP (List Processing) programming language. It merges intelligent educational system with electronic textbook programs in a unique environment in which the user can extend and deepen prior acquired knowledge. It was utilized as an intelligent interactive electronic textbook on programming in LISP programming language logic [70] [71].

- **The study of (Alhabbash et. al., 2016). An Intelligent Tutoring System for Teaching Grammar English Tenses**

In this article, the authors present the design of an Intelligent Tutoring System for learning English language grammar to assist students teach English grammar smoothly and easily. The system supplies all subjects of English grammar and generates a series of questions automatically for each subject for the students to fix. The system adapts with all the individual differences of students and begins gradually with students from easier to harder levels. The intelligent tutoring system was given to a group of students of all age groups to test it and to view the effect of the system on students. The outcomes displayed a better satisfaction of the students toward the system [72].

- **The study of (García et. al., 2016) Intelligent Tutoring System to Integrate People with Down Syndrome into Work Environments.**

Multiple staged project was designed using the ITS in order to combine people with Down Syndrome into the work environment. The major goal of this project was to design an Intelligent Tutoring System for people with disabilities. this tutor will combine multimodal tools and human emotional feeling analysis to enhance its usefulness. otherwise, in order to confirm the final product reliability in occupational frames, a set of fundamental ergonomic interfaces was created. moreover, several basic clinical research activities were executed to validate those applications and to achieve the possibility of patenting them as medical products [73].

- **The study of (Ibijola, 2016) Automatic Novice Program Comprehension for Semantic Bug Detection.**

In PROUST, the range of problems it could handle was clearly small because it was not designed to evolve; it contained a pool of static knowledge about the problem domain. The novel method presented in this thesis performed a similar function as PROUST but at a higher level of complexity; handling more programming problems dynamically [74].

3.1 Comments about previous studies

Through reading these previous studies, I found that the design of Intelligent Tutoring System is used for a variety of matters and the previous studies above aim to use it in many fields such as programming language (PHP, Java, and C #), Mathematics, Algebra and Learning English grammar.

My thesis is different from the previous studies in its goal that it employs artificial intelligence to make the learning process easier, more flexible and effective, with a design that addresses an important part of the Cloud Network Security issue which it's Learning Cloud Network Security Based on biometrics Cryptography, and it's an obstacles in order to overcome them by encouraging people to use it and promote their education and commitment in the development of secure clouds.

4. COMPUTER NETWORK

A Computer Network, or Data Network, is a digital telecommunications network which, allows nodes to sharing of resources. In computer networks, computing devices exchange data with each other via connections (data links) between nodes. These data links are built up over cable media such as optic cables or wires or wireless media like WiF [75].

4.1 Cloud

The term cloud has been used historically as a metaphor for the Internet. This use was primarily derived from its public depiction in network diagrams as an outline of a cloud, used to represent transmit of data across carrier backbones (which the cloud owned) to an endpoint place on the other side of the cloud. This conception dating return as soon as 1961, when Professor John McCarthy suggested that

computer time-sharing technology might lead to a future where computing, impose and even special applications might be sold through a utility-type business model. This conception turned into very popular in the late 1960s, but by the mid-1970s the conception disappeared away when it turned into pure that the IT-related technologies of the day were unable to look after such a futuristic computing model. And so on, ever after starting of the millennium, the conception has been restored. It was meantime this time of restored that the term cloud computing start to spring in technology circles [76].

4.2 Cloud Network

Cloud Networking indicates to hosting or utilize several or all network resources and services —bandwidth, virtual firewalls, virtual routers, or network management software— from the cloud, if private, public, or hybrid. The network can be entirely cloud-based or cloud-enabled.

4.2.1 Cloud-enabled networking

Essence network infrastructure—packet forwarding, data, and routing— remains in-house, but things like monitoring, network management, security services, maintenance and are made during the cloud. Such as using a SaaS-based firewall to preserve an on-premises network. In cloud-enabled networking, in this type, the network is on premises, but several or all resources utilized to control it are in the cloud [77].

4.2.2 Cloud-based networking

This involves physical hardware and network management resources. Cloud-based networking is utilized to supply connectivity between resources deployed and applications in the cloud. In cloud-based networking, in this type, the entire network is in the cloud [78].

4.3 The Emergence of Cloud Computing Network

Utility computing can be defined as the saving of storage and computational resources as a measured service, similar to those provided by a traditional public utility corporation. This, naturally, is not a novel idea. This form of computing is increasing in publicity, but, as companies have started to expand the model to a cloud computing paradigm supplying virtual servers that IT users and departments can access on demand. Early project adopters applied utility computing fundamentally for non-mission-critical needs, but that is fast changing as reliability and trust problems are resolved. Several people believe cloud computing is the next big thing in the world of IT. Others think it is just another difference of the utility computing model that has been repackaged in this decennium as things cool and novel. Nevertheless, it is not just the buzzword "cloud computing" that is giving rise to confusion among the populace. Presently, with some cloud computing vendors in fact practicing this form of technology and nearly each analyst, from every research organization in the state defining the term differently, the concept of the term has become very foggy. Even between those who believe they understood it, Concepts vary, and most of those Concepts are hazy at best. When "the cloud" is joined with "computing," it occurs a lot of confusion. Technology vendors and Market and research analysts alike tend to define cloud computing very tightly, aas new type of utility computing that essentially employs virtual servers that have been made ready via the Internet to third parties. Others face to know the term using a very wide, all-involving application of the virtual computing platform. They contend that the cloud is anything behind the firewall perimeter. A more moderation vision of cloud computing believe it the delivery of computational resources from a location other than the one from which you are computing [79] [80].

4.4 The Cloud is Changing Classical Networks

Users all over the world the globe requires secure, reliable access to the applications and data they utilize every day, and the distribution of applications and services via data centers and clouds is creating new challenges for IT. Load balancing and Classical application delivery controllers are no longer enough for delivering and accessing applications in a hybrid and multi-cloud world. Technologies like SD-WAN can help aggregate all types of networks to deliver a consistent user experiment, if users are at home, at a branch office, or on any other network. As well, with applications moving to the cloud, organizations are likewise more vulnerable to internet-based attacks. In state of connecting and then authenticating a user, a secure digital environment—including, web application firewalls, and secure web gateway components—authenticates a user before authorizing access ADC, gateways, based on where they're located, who the user is, and even what device they're on; deploying separate solutions to address each application over a hybrid or multi-cloud environment can be hard to manage and secure. It's sensitive to analysis of applications, users, and devices across the network and gain end-to-end visibility, so it is significant to merge cryptography and biometrics to profit from the strengths of both fields. In this system, while cryptography supplies adjustable and high security levels, biometrics fetches in eliminating and non-repudiation the required to carry tokens or recollect passwords etc.

4.5 Definition of Cloud Computing

In a September, 2011 (NIST) Information Technology Laboratory, cloud computing is defined as follows: Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable and reliable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal consumer management effort or service provider interaction, as seen in Figure 3 [81].

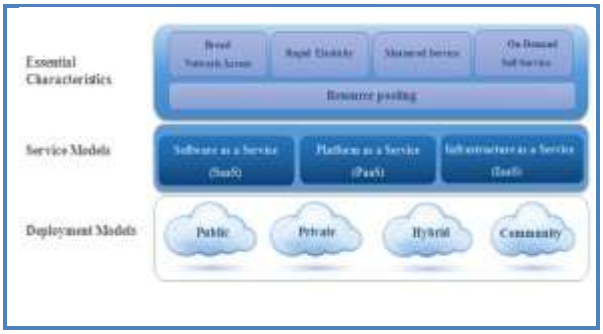


Figure 3 : NIST visual model of Cloud Computing Definition

4.6 Cloud Computing Architecture

This cloud model Consists of five fundamental characteristics, three service models, and four deployment models [82].

4.6.1 Essential Characteristics

The five basic characteristics of the cloud model are as follows [83] [84]:

On-demand self-service

A consumer can unilaterally saving computing capabilities, such as server time and network storage, as wanted automatically without requiring human interaction with each service provider.

Measured service

Cloud systems automatically optimize and control resource utilize by benefit a metering capability at some level of abstraction suitable to the kind of service (e.g., active user accounts, bandwidth, processing, and storage).

Resource use can be reported, monitored, and controlled, providing transparency for both the consumer and the provider of the used service

Rapid elasticity

Capabilities can be rubbery provisioned and freed, in some cases automatically, to scale quickly outwardly and inwardly symmetrical with demand. To the consumer, the capabilities available for supplying often seem to be infinite and can be appropriated at any time in any quantum.

Broad network access

Capabilities are available through the network and accessed over standard technique that enhance usage by heterogeneous thin or thick client platforms (e.g., laptops, mobile phones, workstations and tablets).

Resource pooling

The provider's computing resources are collected to serve multiple consumers employing a multi-tenant model, with various virtual and physical resources dynamically assigned and reassigned depending on consumer demand.

There is a feel of location independence in that the customer in general has no control or knowledge over the perfect location of the provided resources, but might be capable to assign location at a higher level of abstraction (e.g., datacenter, state, or country). Examples of resources include storage, network bandwidth, memory, and processing.

4.6.2 Service Models

Software as a Service (SaaS)

The highest level of a cloud computing environment consists of cloud-based applications. The ability provided to the consumer is to employ the provider's applications running on a cloud infrastructure. The applications are attainable from different client devices via either a thin client interface, like a program interface, or a web browser (e.g., web-based email). The consumer does not control or manage the underlying cloud infrastructure, including network, storage, operating systems, servers, or even individual application capabilities, with the potential exclusion of limited user specified application configuration settings [85] [86].

Platform as a Service (PaaS)

The ability provided to the consumer is to deploy onto the cloud infrastructure, consumer-created or gained applications created utilizing programming languages, services, libraries, and tools supported by the provider. The consumer does not control or manage the underlying cloud infrastructure [87], including networks, servers, storage, or operating systems, but has control over the deployed applications and probably configuration settings for the application-hosting environment [88].

Infrastructure as a Service (IaaS)

The ability provided to the consumer is to provide storage, networks, and other fundamental computing resources where the consumer is capable of deploys and runs arbitrary software, which can contain applications and operating systems. The consumer does not control or manage the underlying cloud infrastructure but has control over the storage, deployed applications, and operating systems ; and probably restricted control of choosing networking components (e.g., host firewalls) [89].

Security as a Service (SECaaS)

Security as a service (SECaaS) is a new business model has been applied by The Cloud Security Alliance (CSA) to the NIST Service Models in which a service provider merges their security services into a common infrastructure on a participation basis more cost effectively than most companies or individuals can provide on their own, when the overall cost of ownership is considered. These security services usually involve authentication, intrusion detection, anti-virus, Penetration testing, anti-malware/spyware, and security event management, among others. SECaaS serves as a stop against the most continual online threats[90].

4.7 Deployment Models

Private cloud

The cloud infrastructure is provided for exclusive use by a single organization contains multiple consumers (e.g., business units). It might be managed, and possessed by the organization, a third party, or some collection of them, and it operated may exist on or off construction [91].

Community cloud

The cloud infrastructure is provided for exclusive usage by a specified community of consumers from organizations that have shared interest (e.g., security, requirements, policy, compliance considerations and mission). It may be possessed, operated, and managed by one or more of the organizations in the community, a third party, or some collection of them, and it may exist on or off construction [92].

Public cloud

The cloud infrastructure is provided for open usage by the general public. It might be managed, operated, and owned by a government organization, academia, or, business or some collection of them. It exists in the construction of the cloud provider [93].

Hybrid cloud

The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds) [94].

4.8 Cloud Computing Advantages

Cloud computing supplies numerous advantages both to end users and businesses of all sizes. The clear huge benefits is that you no more need to support the infrastructure or need the knowledge needful to improve and preserve application or the infrastructure, development environment , the load has been shifted and somebody else is looking after of all that. Business are present capable of concentrate on their essence business by outsourcing all the conflict of Information Technology infrastructure. Let's display some of more important advantages of cloud computing. Those will involves both an end-user and an organization's perspective [95]:

Cost Savings

Possibly, the generality important cloud computing advantage is in terms of IT cost savings. Businesses, Regardless what their size or type exists to gain money while keeping capital and operational expenses to a minimum. With cloud computing, you can save substantial capital costs with application requirements and zero in-house server storage. The reduction of on-premises infrastructure also eliminates their associated operational costs in the form of administration costs, air conditioning and power. Your payment for what is disengaged and used whenever you like - there is no exploited IT capital to worry about. It's a common misconception that only large businesses can tolerate to usage the cloud, while in fact, cloud services are very affordable for minimal businesses.

Reliability

With a managed service platform, cloud computing is much more reliable and consistent than in-house IT infrastructure. Most providers offer a Service Level Agreement, which guarantees 24/7/365 and 99.99% availability. Your organization can benefit from a massive pool of redundant IT resources, as well as a quick failover mechanism - if a server fails, hosted applications and services can easily be transmitted to any of the available servers.

Manageability

For a managed service platform, cloud computing is much more consistent and reliable than in-house IT infrastructure. Most providers present a Service Level Agreement, which guarantees 24/7/365 and 99.99% availability. Your organization can advantage from a huge pool of redundant IT resources, as well as fast failover technique - if a server fails, services and hosted applications can easily be transported to any of the available servers.

Strategic Edge

Ever-growing computing resources, grant you a competitive edge over rival, at the time you require for IT procurement is not negligible. Your organization can deploy mission critical applications that transfer important business advantages, without any upfront costs and least provisioning time. Cloud computing lets you to overlook about technology and concentrate on your key business objectives and activities. It can also assist you to minimize the time required to market newer services and applications.

4.9 Cloud Computing Disadvantages

The most disadvantages of Cloud Computing are those frequently mentioned [96]:

Downtime

As cloud service providers care of a number of clients every day, they can feel tired and may even come up versus technical outages. This can lead to your business processes being temporarily suspended. Additionally, if your internet connection is offline, you will not be able to access any of your applications, server or data from the cloud.

Performance stabilities

Although, in most situations, performance in a cloud is very stable, there are sometimes when the cloud infrastructure is under large loads. . The performance for an application in a cloud environment will based on the resources and network traffic the other virtual machines running on the same physical machine as the application's virtual machine are taking. It can be hard to iterate the performance demonstrated from one run to another [97].

Inflexibility to switch

Because of the truth that various cloud providers may offer various levels of services (e.g. , Amazon EC2 provides laaS, Salesforce provides SaaS, Google App Engine provides PaaS) and APls, it might be hard for a user to switch from one cloud provider to another (Androutsellis, Spinellis, 2004). This is also defined as the "lock-in" problem in other literatures. In public, laaS provides easier possibilities of switching than PaaS while SaaS is the hardest one to switch to or from.

Network speed

There are two network speeds that require to be pointed here: one is inter-cloud speed and the other is intra-cloud network speed. Inter-cloud speed points to the network speed among the cloud provider and the user or between various

cloud providers. Intra-cloud network speed is the network transfer speed into the cloud infrastructure. It is usually limited by switches in the cloud infrastructure network. Based on the cloud infrastructure network setup, this intra-cloud network speed might change. For any message or data passing heavy applications, the latency may not be acceptable.

Data lock-in

Using Geographic Information System (GIS) applications as an example, a typical GIS application generally include a big deal of data. The data format and how data are stored might produce a large performance various to the GIS application. Also, data export and import in a GIS application might be very significant in some statues [98].

Vendor Lock-In

While cloud service providers pledge that the cloud will be integrated and flexible for usage, changing cloud services is thing that hasn't yet completely developed. Organizations may discover it hard to migrate their services from one vendor to another. Integrating and hosting current cloud applications on another platform might throw up support issues and interoperability. For example, applications involved in the Microsoft Development Framework (.Net) may not work completely on the Linux platform.

Limited Control

As the cloud infrastructure is fully managed, owned and monitored by the service provider, it transmits minimal control of the customer. The customer can only manage and control the applications, services and data operated on top of that, not the backend infrastructure itself. Main administrative tasks like server shell access, updating and firmware management may not be passed to the customer or end user.

There are four generic methods of authenticating a user's identity, which can be utilized singly or in combination:

Something the individual knows: Examples involve a personal identification number (PIN), a password, or answers a Pre-set of questions.

Something the individual possesses: Examples involve smart cards, electronic keycards, physical keys, and cryptographic keys. This kind of authenticator is pointed to as a token.

Something the individual is (static biometrics): Examples involve recognition by face, retina, and fingerprint.

Something the individual does (dynamic biometrics): Examples involve recognition by handwriting characteristics, voice pattern, and typing rhythm.

All of these means, just used and implemented, can supply secure user authentication. Nevertheless, each means has problems. An adversary might be capable to steal or guess a password. Similarly, an adversary might be capable to steal or forge a token. A user might lose a token or forget a password. Moreover, there is an important administrative overhead for managing securing such information on systems and token information on systems and password. Taking into consideration biometric authenticators, there is a set of problems, including dealing with false negatives and false positives convenience, cost and user admission. With network-based user authentication, the most significant means include cryptographic keys and something the individual knows, such as password [99].

4.10 Cloud Security and Privacy

Notwithstanding, cloud service providers perform the best industry certifications and security standards, storing important files and data on external service providers constantly opens up risks. Employing cloud-powered technologies mean you want to provide your service provider with access to significant business data. Meantime, being a public service opens up cloud service providers on a routine basis to security challenges .The relief in accessing and procuring cloud services can also allow outrageous users the capability to browse, exploit and identify vulnerabilities and loopholes within a system. For example, in a multi-tenant cloud architecture where multiple users are hosted on the same server, a hacker may attempt to break into the data of other users hosted and stored on the same server. Nevertheless, like loopholes and exploits are not probable to surface, and the likelihood of a compromise is not major. This would be a big worry to anybody who is thinking putting their data into a third-party storage space. Because users will not realize exactly where their data are going to be saved and who would have the privilege to access it into the cloud infrastructure. Some Cloud Computing providers may allocate their data centers in various states. The data stored in these stats may meet several regulations and are thus protected or unprotected according to the local governments.

It is simple to show how the benefits of cloud computing simply exceed the drawbacks. Reduced costs, decreased downtime, and low management effort are interests that talk for themselves.

This section addresses the core theme of this chapter, i.e., the security and privacy-related challenges in cloud computing. There are numerous security issues of cloud computing as it encompasses many technologies including networks, databases, operating systems, virtualization, resource scheduling, transaction management, load balancing, concurrency control and memory management.

4.10.1 Security

Cybersecurity is the maintenance of Internet-connected systems, involving data, programs and devices, from cyber-attacks.

Computing security includes physical security and cybersecurity –-both are utilized by companies to protect against unauthorized access to computerized systems and other data centers.

Information security which is intended to protect the confidentiality, integrity and availability of information, is a subset of cybersecurity [100].

4.10.2 Network Security

Network security is the security supplied with a network from the risks and unauthorized access. It is the obligation of network administrators to take on preventive measures to keep their networks from possibility security threats. Computer networks that are involved in communication and orderly transactions within the individuals, government, or business require security. The most popular and simple method of protecting a network resource is by specifying it a unique name and a conformable password [101].

4.10.3 Cloud Security

Cloud computing security or cloud security mentions to a wide set of controls, technologies, policies are deployed to protect data, applications and the related infrastructure of cloud computing. It is a sub-domain of network security, computer security, and, in general, information security. By 2014, Cloud Computing had progressed its primary features, and security had turned into the basic focus. Cloud security has become a rapidly-growing service, in order that its significance to customers. Cloud security has advanced safely in the previous two years, and at present provides protection similar to traditional IT security systems. This contains the protection of critical information from theft, data leakage, and accidental deletion. Security is, and might always be, the major concern of most Cloud users [102].

4.10.4 Cloud Computing Security and Privacy Issues

Security issues for several of these technologies and systems are applicable to cloud computing. Such as, the network that interconnects the systems in a cloud has to be secure. Also, virtualization paradigm in cloud computing drives to many security worries. For instance, in physical machines that mapping the virtual machines be carried out securely. Data security includes encrypting the data and ensuring that suitable policies are implemented for data sharing. As well as, memory management algorithms and resource distribution must be secure. Lastly, data mining techniques might be applicable for malware detection in the clouds that is a method which is generally adopted in intrusion detection systems.

There are six concern fields of the cloud computing environment where hardware and software need essential security concern [103] [104] [105] [106] [107] [108].

These six field are:

(1) Security of data in passage,

(2) Security of data at rest,

(3) Strong separation between data belonging to various customers,

(4) Authentication of processes/applications/ users,

(5) Incident response, and

(6) Cloud regulatory and legal issues.

To securing data at rest, cryptographic encryption techniques are obviously the best choice. At present, the hard drive industrialists are shipping self-encrypting drives that execute authenticate storage standards of the authenticated computing group. These self-encrypting drives established encryption hardware into the drive, supplying automated cryptography with lower cost or performance effect. Though software cryptography can as well as be utilized for protecting data, it makes the process minimal secure and delayer after it might be potential for an adversary to theft the encryption key without being detected.

Cryptography is the best choice for securing data in transmission also. As well as, authentication and integrity protection techniques guarantee that data only leaves where the customer needs it to leave and it is not altered in transit.

4.10.5 Cloud Security Threats

The threats to information possessions establish in the cloud can alter depending on the cloud delivery models utilized by cloud user companies. There are many kinds of security threats to which cloud computing is vulnerable. Table 3 displays an overview of the threats for cloud customers classified based on the confidentiality, integrity and availability (CIA) security model and their relation to each of the cloud

Service delivery model [109].

Table 3: A list of cloud security threats

Threat	Description
Confidentiality	
Internal user threats: • Malicious cloud customer user • Malicious cloud provider user • Malicious third party user (Supporting either the customer organizations or cloud provider)	The threat of internal accessing customer data to assist within the cloud is bigger as all of the delivery models can insert the require for multiple insider users: IaaS- third party platform consultants. PaaS- test environment managers and application developers. SaaS – provider administrators and cloud customer.
External attacker threats: • Remote software attack of cloud infrastructure • Remote hardware attack against the cloud • Remote software attack of cloud applications Social engineering of cloud provider, cloud customer users and users. • Remote hardware and software attack against cloud user organizations' endpoint hardware and software	The threat from external attackers may be looking to implement more to public Internet overlay clouds, but all kinds of cloud delivery models are influenced by external attackers, especially in private clouds where user endpoints can be aimed. Cloud providers with personal information, big data stores holding credit card details, and intellectual property or critical government, will be submitted to attacks from sets, with important resources, tried to recover data. This involves the threat of supply chain attacks, social engineering and

	hardware attack by dedicated attackers.
Data leakage: • Fail of security access rights via multiple domains • Fail physical of and electronic transfer systems for backups and cloud data	A threat from diffuse data leakage between several, potentially competitor companies, utilize the same cloud provider could be made by faulty hardware or human error that will drive to expose information.
Integrity	
Data segregation: • Improperly located security environments • Improper configuration of hypervisors and virtual machines	The integrity of data within intricate cloud hosting environments like SaaS configured to share computing resource between customers could provide a threat against data integrity if system resources are efficiently separated.
User access: • weakness access management procedures and identity	Application of weakness access control procedures makes several threat opportunities, such as that indignant ex-employees of cloud provider companies preserve remote access to administer customer cloud services, and can make meant wastage to their data sources.
Data quality: • Introduction of infrastructure components or incorrect application	The threat of the effect of data quality is raised as cloud providers host several customers' data. The insertion of a misconfigured or wrong component needed by another cloud user could potentially affect the integrity of data for other cloud users sharing infrastructure.
Availability	
Change management: • Customer penetration testing affecting other cloud customers • Infrastructure exchanges over cloud provider, customer and third party systems affecting cloud customers	As the cloud provider has rising responsibility for altering control within all cloud delivery models, there is a threat that alterations could insert inefficient effects. These could be driven by software or hardware exchanges to present cloud services.
Denial of service threat: • Network bandwidth distributed denial of service • Data and application denial of service • Network DNS denial of service	The threat of denial of service against available cloud computing resource is usually an outsider threat against public cloud services. And so on, the threat can affect all cloud service models as an outsider and insider threat agents could insert hardware or application components that cause a denial of service.
Physical disruption: • Disruption of cloud customer Information Technology (IT) services out of physical access • Disruption of cloud provider Information Technology (IT) services out of physical access	The threat of disruption to cloud services caused by physical access is various between big cloud service providers and their customers. These providers must be experienced in securing big data center facilities and have deemed flexibility between other availability strategies. There is a threat that cloud user infrastructure can be physically disrupted more facilely whether by internal or outsider where remote working is standard practice or minimal secure office environments.
Exploiting poor recovery procedures: • Invocation of unsuitable business continuity processes or disaster retrieval	The threat of inappropriate retrieval and incident management procedures being initiated is increased when cloud users look retrieval of their possess in house systems in parallel with those controlled by third party cloud service providers. If these procedures are not examined, then the effect upon retrieval time might be important.

4.10.6 Kinds of Attackers in Cloud Computing

Several of the security threats and challenges in cloud computing will be famed to companies controlling in house infrastructure and those implicated in classical outsourcing models.

All of the cloud computing service delivery models' threat effect from the attackers that can be split into two sets as shown in Table 4.

Table 4: A list of attacks on cloud computing environments

Security threats	Possible defense Techniques
External attackers	**An external attacker has the following characteristics:** • Is not employed by the cloud service provider, customer or other third party provider organization supporting the

	operation of a cloud service • Has no authorized access to cloud services, customer data or supporting infrastructure and applications • Exploits technical, operational, process and social engineering vulnerabilities to attack a cloud service provider, customer or third party supporting organization to gain further access to propagate attacks against the confidentiality, integrity and availability of information within the cloud service.
Internal attackers	**An internal attacker has the following characteristics:** • Is used by the cloud customer, or service provider, other third party provider companies providing the process of a cloud service • Might have present authorized access to applications or providing infrastructure and cloud services, customer data, based on their organizational role • Utilize present privileges to earn moreover access or support third parties in performing attacks against the confidentiality, integrity and availability of information in the cloud service.

Though internal and external attackers can be plainly distinguished, their ability to perform succeeded attacks is what distinguishes them as a threat to vendors and customers.

Attackers can be classified into four kinds in the cloud environment: substantial, strong, weak, and random [110].

All of these classes depend on capability to drive a succeeded attack, rather than on the kind of threat they current (i.e., terrorism, espionage or criminal):

• **Substantial:** Motivated, strong attackers not readily discovered by the companies they attack, or even by the pertinent law enforcement and investigative companies specializing in electronic Crime or cyber security. Relaxing this threat needs major intelligence on attacks and particulars resources in reply to the exposure of an incident or threat.

• **Strong**: Organized, well-financed and deftly sets of attackers with an inside hierarchy specializing in targeting particular users and applications in the cloud. Usually this set will be an orderly crime set specializing in big scale attacks.

• **Weak**: Semi-deft attackers aimed given servers/cloud providers by customizing present publicly obtainable tools are given aims. Their process is more progressing as they try to customize their attacks employing available exploit tools.

• **Random:** The most popular kind of attacker utilizes easy tools and techniques. The attacker might at random look at the Internet attempting to discover vulnerable components. They will deploy well defined tools or techniques that should be simply detected.

4.10.7 Cloud Security Risks

The security risks related with each cloud delivery model differ and are based on a broad area of factors involving the critical of information assets, cloud security and architectures control include in a special cloud environment. Table 5 briefs the security risks related in the cloud computing paradigm.

Table 5: A list of security risks in cloud computing

Risk	Description	Possible solutions
Privileged user access	Cloud providers usually have unbounded access to user data, controls are needed to handle the risk of privileged user access driving of compromised customer data.	**Firstly**, cryptography of the data before to login into the cloud to divide the capability to store the data from the capability to do utilized on it. **Secondly**, legally enforcing the needs of the cloud provider during contractual commitments and emphasis mechanisms to guarantee that Confidentiality of the data is maintained to desired standards.
Data location and segregation	Customers might not inform where their data is being stored and there might be a risk of data being stored beside the other customers' data.	Virtualization is exclusive of a number of enabling mechanisms of cloud computing that it is a run-time process of separation for processing data. Several of the security concerns and problems related with virtualization are related in cloud computing, in any case, if or not the cloud service provider utilizes virtualization mechanisms. Security of data based on having suitable security controls in each of the layers of the

		virtualized environment. Moreover, secure cancel of memory and store should be utilized to prohibit data wastage in a multi-tenant environment wherever systems are reused.
Data disposal	Cloud data cancel and elimination is a risk, especially where hardware is dynamically released to customers depend on their requires. The risk of data not being canceled from data stores, physical media and backups through taking apart is developed within the cloud.	Cloud services that display data storage usually provide either guarantees or service-level goals concerning high availability of that data. Cloud providers obtain this by saving multiple copies of the data. Where the cloud customer has a need to cancel data, cloud-based storage might be unsuitable for that data at all dots in its lifecycle. Based on the kind of data hosted in the cloud, customers might need providers to cancel data in accord with manufacture standards. Except if the cloud architecture specially frontiers the media on which data might be stored and the data possessor can delegation utilized of media Release mechanisms on that media in line with the need standards, customers might require to prevent their data from being transferred in the cloud.
	The possibility for	Customers should

E-investigations and Protective monitoring	cloud customers to invoke their possess electronic inquiry procedures within the cloud can be restricted by the delivery model in utilize, and the complexity and access of the cloud architecture. Customers can not efficiently deploy controlling systems for infrastructure they do not possess; they should depend on the systems in utilize by the cloud service provider to support the inquiry.	address this issue within their contractual agreements with providers, and understand how their provider implements protective monitoring within their cloud environment. Collecting digital evidence within the cloud should be the responsibility of the cloud service provider, and it should be handed over as part of the chain of custody of evidence to the customer for their own investigation process.
Assuring cloud security	Customers cannot readily emphasize the security of systems that they do not directly monitor without employing SLAs and owning the right to examine security controls into their conventions.	Defining security needs – The customers' information security needs are extracted from the company's own policy, legal and Organizational commitments, and might load during from other convenes that the organization has with its customers. Due diligence on cloud service providers – possible cloud customers must promise suitable due-diligence on providers prior entering into a formal relevance. • Managing cloud provider risks – The outsourcing of key services to the cloud might need customer companies. Efficient risk control also

		needs maturity both in vendor relationship control procedures and procedural security processes.

4.10.8 Possible Defense Techniques:

Table 6 summarizes an important security issues in cloud computing and their potential defense techniques [111].

Table 6: Cloud computing threats and suggested defense techniques for these threats.

Security threats	Possible defense Techniques
Spoofing identity	Authentication Don't store secrets Protect secrets
Tampering with data	Authorization signatures Tamper-resistant protocols Hashes Message authentication codes Digital
Repudiation	Digital signatures Audit trails Time-stamps
	Authorization Don't store secrets Encryption Protect secrets Privacy-enhanced protocols
Denial of Service (DoS)	Authentication Quality of service (QoS) Filtering Authorization Throttling
Elevation of privilege	Run with least privilege

5. CRYPTOGRAPHY

Cryptography is viewed as the one of the building blocks for the security. Until modern times, cryptography referred almost exclusively to encryption, which is the process of converting ordinary information (called plaintext) into unintelligible form (called ciphertext) [112]. Decryption is the reverse, in other words, moving from the unintelligible ciphertext back to plaintext. A cipher (or cypher) is a pair of algorithms that create the encryption and the reversing decryption.

The detailed operation of a cipher is controlled both by the algorithm and in each instance by a "key". The key is a secret (ideally known only to the communicants), usually a short string of characters, which is needed to decrypt the ciphertext.. Information can be encoded and decoded with the support of cryptographic keys. It includes high security and a hacker can't be capable to hack the Information. AES, DES and public key architectures are very using cryptographic techniques. Cryptographic security is depended by an authentication step that relies upon the pseudo random keys, which are unattainable to keep in mind. The disability of human users to remember strong cryptography keys assists to include the security. Many historical cases show that a person is able to remembering only small passwords or keys. Ordinarily store keys and write down in an insecure location can make Communistic between users, and so is not able to nonrepudiation. Extra over, many people are prepared towards utilizing identical passwords and keys for a variety of applications .This makes the task of an attacker to be widely simple and its drive to decrease the security. Therefore Biometric supplies a person with distinguished characteristics that is constantly unique. Diverse biometric techniques that are under research contain fingerprints, face, retinal, iris scans and hand geometry, signature capture and vocal features [113]. The using of Biometrics and cryptography technologies together have confirmed their significance in a variety of security, monitoring applications and access control. For example, Humans have applied fingerprints for individual identification of many decades and matching accuracy is very high for fingerprint.

5.1 The Idea of Cryptography

Cryptography is the study of the mathematical techniques linked to parts of Information security, such as data integrity, confidentiality and authentication. The head idea of cryptography is to convey information over an insecure channel and guarantee that no entity in the middle can understand what is being transmitted. The history of cryptography come back all the way to the Egyptians about 4000 years ago. It was also utilized widely through the world wars.

As an explanation, we can consider of two people, Alice and Bob, who want to shift the data back and forth in such a way that a third person, Oscar, is a competitor and can listen to the transmission but cannot decrypt the data being transmitted [114]. The data that Alice intending to send is known plain text because it is not yet encrypted. Alice encrypts the plain text with a predefined key known the encryption key and passes encrypted text over the dangerous channel to Bob. Bob, who have the encryption key, can decipher the encrypted text to get plain text. Oscar, which does not get the encryption key, cannot decode the encoded text [115]. Cryptography is perhaps the most significant aspect of communications security and is becoming increasingly significant as a basic building block for computer security. The increased usage of computer and communications systems by industry has risen the risk of theft of proprietary data. Though these threats may need a variety of countermeasures, encryption is a main process of protecting valuable electronic data.

5.2 Types of Cryptography

Novel cryptography can be parted into two main subfields of study: Symmetric-key cryptography and Asymmetric-key cryptography (public) see Figure 4 .

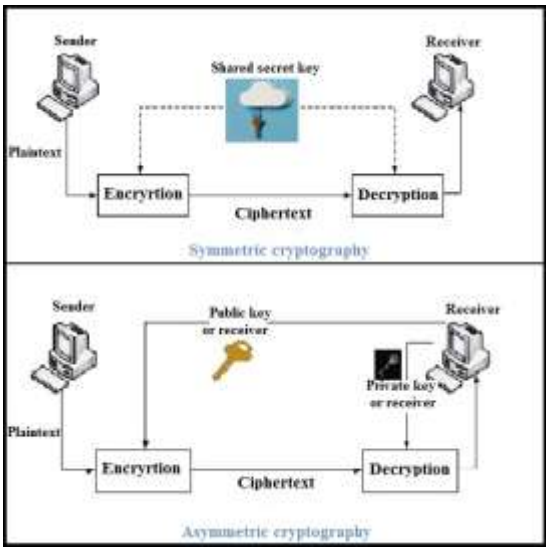


Figure 4 : Basic cryptography systems

Several encryption algorithms are very available and applied in information security. They can be classified into symmetric (private) and asymmetric (public) keys cryptography. In symmetric keys cryptography or secret key cryptography, only one key is used to encrypt and decrypt data. The key should be distributed before transmission between entities. Keys play a significant role. If poor key is utilized in algorithm then everyone might decrypt the data. Power of symmetric key cryptography based on the size of key utilized. For the same algorithm, cryptography utilizing lengthy key is more complex to break than the one done utilizing smaller key. There are many instances of weak and strong keys of cryptography algorithms like RC2, 3DES, RC6, Blowfish, and AES. But major problem with this is secure transmission of key over the malicious network. Asymmetric key cryptography or public key cryptography is utilized to fix the problem of key distribution. In asymmetric keys, two keys are utilized; private and public keys. Public key is utilized for encryption and private key is utilized for decryption (E.g. Digital Signatures and RSA). Users utilized two keys : public key, which is defined to the public and private key which is defined only to the user. There is no require for distributing them prior to transmission. Nevertheless, public more key encryption is based on mathematical functions, computationally intensive and is not very effective for few devices [116].

5.3 Definition of Cryptography in the Cloud

Cryptography in the cloud uses encryption mechanisms to secure data that will be employed or stored in the cloud. It lets users securely and conveniently access shared cloud services, as any data that is hosted by cloud providers is protected with encryption. Cryptography in the cloud protects critical data without delaying information exchange [117].

Cryptography in the cloud lets for securing sensitive data beyond your corporate IT environment, where that data is no longer under your dominance or control.

Cryptography expert Ralph Spencer Poore illustrates "information in motion and information at rest are best protected by cryptographic security measures. In the cloud, we don't have the luxury of having real, physical control over the storage of information, so the only way we can ensure that the information is protected is for it to be stored cryptographically, with us preserving control of the cryptographic key." [118].

Cloud storage providers present cloud cryptography services to encrypt information before it is transmitted to the cloud for storage. Ideal cloud cryptography applications range from cryptography connections to restricted cryptography only of data that is defined to be critical (like account credentials) to end-to-end cryptography of any data that is uploaded to the cloud. In that models, cloud storage providers encrypt data upon reception, crossing cryptography keys to the customers so that data can be safely decrypted when necessary.

Encryption is respected as one of the most efficient methods of data security, mixing the content of any file, database, or system in such a way that it's unattainable to decipher without a decryption key. By applying encryption and practicing secure encryption key management, organizations can assure that only authorized users have access to critical data. Even if accessed, stolen, or lost without authorization, encrypted data is unreadable and basically unmeaning without its key.

5.4 Cloud Cryptography Challenges

One of the fundamental challenges related to encryption as a full is the simple fact that it's underutilized, despite its certain effectiveness at supporting data security. As more enterprises and request senior security measures, from cloud providers to develop compliance while preserving efficiency, usage is becoming more popular Encryption push costs for cloud storage providers (and only their customers) due to the extra bandwidth wanted to encrypt data before it is transmitted to the cloud. As a result, many providers limit their cloud encryption services while some cloud storage customers easily encrypt their own data on-premises before it is transmitted to the cloud. Some cloud customers will select this way in any case, as it can save costs while preservation the entire encryption process and all keys within their environment, transmitting data to the cloud only after it has been encrypted.

5.5 Benefits of Cloud Cryptography

The primary benefit of cloud cryptography is the same as in any application of cryptography: encrypted data is only readable for authorized users with access to the decryption keys. Encrypting data assure that even if that data falls into the improper hands, it is valueless thus its keys remain secure. This is especially helpful when data is being stored in the cloud, as it maintains data contents in the incident that is compromised, a provider system, or account.

Any company within these manufactures that has rely on the cloud must be prepared to meet the security challenges that derive with cloud storage and use services .

Cloud Cryptography gives organizations to be proactive in their defense versus data cyber-attacks and violations and has be a need in today's data-driven world. Cloud Cryptography is as well as important for manufactures that need to meet organizational compliance needs . cryptography, when collected with other security measures, can companies meet the hard compliance needs of SOX (for financial reporting), PCI DSS (for retail e-commerce and organizations), HIPAA (for business associates and healthcare organizations) [119] .

5.6 Cloud Cryptography Best Practices

When choosing a cloud storage provider, plain your security needs for your cloud deployment and any data that shall be transported to the cloud. choose what data would be encrypted and choose a cloud provider offering sufficient encryption for those needs . For example, a marketing group use cloud storage for graphics and videos might only require cryptography for their account credentials, but not for any data uploaded to the cloud. Furthermore, engineers utilize cloud storage services to share source code and design documents will probably require cloud providers with end-to-end encryption. At least, choose cloud providers that usage HTTPS to guaranty that all connections are encrypted.

When possibility, sensitive data that is to be uploaded to the cloud have to be encrypted on-premises, prior to upload. This ensures that data ought to be secure in the cloud even if your account or cloud storage provider is compromised. Secure encryption key management – both for your keys provided by a cloud vendor and any keys – is critical too. Encryption keys must be stored separately from the encrypted data to assure data security. Key backups also must be saved off-site and audited regular. Other significant practice for key management is to execute multi-factor authentication for both the master and recovery keys. Another encryption key significant practices include refresh keys periodically, basically if keys are group to expire spontaneous. Some enterprises choose to encrypt keys themselves, but that can add up unnecessary complexity in some cases. Nevertheless, there are many challenges linked to cloud cryptography, data security needs and business regulations do it a need. Data security and privacy experts correspond that cryptography is a critical tool for data security, and cloud providers present different applications of cryptography to appropriate a range of information security needs and budgets. Taking the time to understood your cloud data security needs, research the cryptography services offered by different cloud vendors, and map for secure cloud adoption will give your business to winning the advantages of cloud storage and computing without putting your information at unnecessary risk.

5.7 Cloud Cryptography and Security

The advantages of cloud computing are being done by more enterprises and companies daily. Cloud computing grants clients a virtual computing infrastructure on which they can execute applications and store information. Nevertheless, cloud computing has incorporated security challenges to address client data and cloud operators store outside of the area of clients' present security measurements. different companies are improving cryptographic protocols tailored to cloud computing in an experience to efficiently balance security and performance.

Most cloud computing infrastructures do not supply security against untrusted cloud operators, which confuses a challenge for organizations and companies that want to store confidential, sensitive information like high-impact business data, financial records, or medical records. As cloud computing continues to gain in publicity, there are numerous cloud computing researchers and companies who are pursuing cloud cryptography projects because handle the business demands and challenges relating to data protection and cloud security.

There are different approaches to extending cryptography to cloud data. Many organizations select to encrypt data before uploading it to the cloud completely. This process is useful because data is encrypted prior it leaves the organization's environment, and data can only be decrypted by authorized parties that own access to the appropriate decryption keys.

Other cloud services are capable of encrypting data onto the receipt, guarantee that any data they are transmitting or storing is protected by encryption by default. Some cloud services might not display encryption abilities, but at the very lower ought to utilize encrypted connections like SSL or HTTPS to guarantee that data is secured in transmission .

5.8 Cloud Cryptography and Crypto Management

Organizations and companies want to pick a data-centric method for protecting their critical data because the keeper against progress threats in the cloud services, mobility, evolving and complex environments of virtualization. Organizations must perform data security solutions that provide consistent protection of critical data, including cloud data protection during cryptographic key management and encryption. A comprehensive platform for encryption and cloud security as well should transport strong key management capabilities and access controls that enable companies to practically, comprehensively leverage encryption to address security objectives, and cost effectively.

5.9 Biometrics

Biometrics is a technology which utilizes physiological or behavioral traits of a human being for the aim of either verification or identification. The common utilize of biometrics technology is there at present a day in respect of no require to remind any password or other things or no require to take something such as smart card or token with you. The person will be identified depends on his unique behavioral or physical characteristics [120].

Usually utilized biometrics technologies are: fingerprint, hand geometry, face, iris, keystroke, retina voice, etc.

Figure 5, illustrates the typical working of Biometric System, First phase , sensor in the hardware device captures

the image of the feature. Then preprocessing is achieved in the Second phase e.g. rotating the image, thinning of the image. Then, in the following phase, feature extraction is achieved from the image. And Template is generated from the extracted feature. In the next phase, matching is done with template. And finally, outcome is Generated as negative or positive verification or identification.

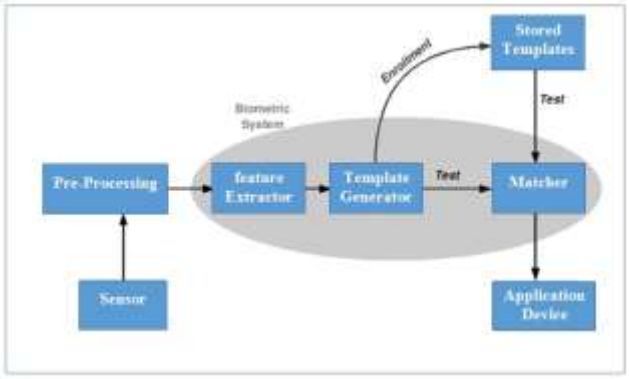


Figure 5: Typical working of Biometric system

Now allow us take a look at the scenario of Cloud and Biometrics. For example in Scheme of the biometric verification system in the cloud. (as shown in Figure 6), and then let us take another look Cloud fingerprint verification in Moodle as example for Cloud Biometric verification (as shown in Figure 7).

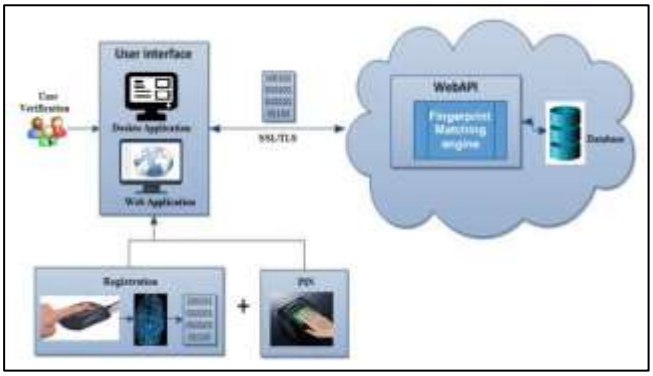


Figure 6:: Scheme of the biometric verification system in the cloud.

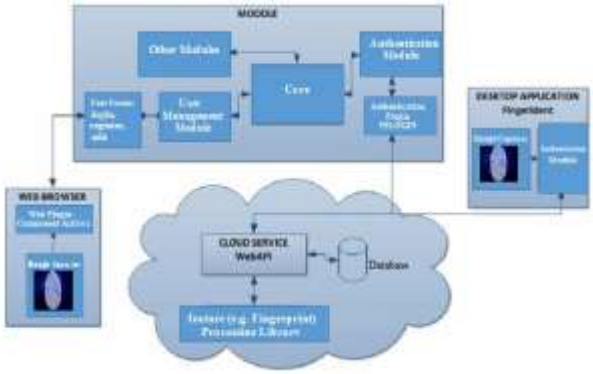


Figure 7: Cloud fingerprint verification in Moodle.

5.9.1 Efficient Cryptographic Key Generation using Biometrics

Advancement of communication technologies in recent times has made in massive quantities of digital data in the publicly shared media. This leads to the strong evolution of cryptographic techniques. Cryptography is considered to be one of the essential building blocks of computer security [121]. Data can be encoded with the help of cryptographic techniques because guarantee that it appears ambiguous to the public or third party and secure only to the intended receivers of it i.e. data confidentiality. The most use cryptographic techniques are DES, AES [122] [123]and public key architectures like RSA [124].

It is almost unattainable to save the cryptographic keys in mind in order to the length of pseudo-random keys is big. Usually we register and store keys in an insecure position; this makes the work of an attacker simple and easy. It is potential to fix this problem with the assist of biometric. A biometric system is a standard process for verification and identify of a human being depend on the physical or personal identification of characteristics. In modern years there is a quick growth in usage of biometrics for user authentication applications; Biometrics and Cryptography are combined in biometric cryptosystem. Biometric key system can be utilized largely in two special methods:

1. Biometric based key generation
2. Biometric matching.

Biometrics comprises methods for uniquely recognizing humans based upon one or more particular behavioral or physical features. In computer science, in specially, biometrics is utilized as a form of identity access control and access management. It is as well utilized to identify individuals in groups that are under observation.

Biometric characteristics can be separated in two essential classes:

- **Physiological**: are linked to the shape of the body. Examples involve, but are not limited to face recognition, fingerprint, Palm print, hand geometry, iris recognition, DNA.
- **Behavioral**: are linked to the behavior of a person. Examples involve, but are not limited to voice and typing

rhythm. Some researchers have put the term behaviometrics for this class of biometrics. To generate cryptographic key we are utilizing any Biometric characteristic such as biometric finger print, the uses are easy to usage, simple, cheap, low power, small size, large database already available, non-intrusive.

Biometric cryptosystems can work in one of the following three modes,

1- Key generation
2- Key release, and
3- Key binding.

In the key release mode, the key and the biometric template are stored as discrete entities and the key is released only if the biometric matching is succeeded [125].

In the key binding mode, the template and the key are monolithically bound within a cryptographic frame work. It is computationally unreasonable to decipher the template or the key without any knowledge of the user's biometric data.

A crypto- biometric matching algorithm is applied to implement authentication and key release in a single step.

Here we are utilizing Key generation mode, in which key is originated from directly from the biometric data and is not store in the database.

It is simple to perform a biometric cryptosystem in the key release mode, such a system is not suitable for high security applications because it has two grate vulnerabilities. First, the biometric template is not secure. Template security is a sensitive issue in biometric systems because stolen templates cannot be revoked. Second, since key release and authentication are decoupled, it is potential to exceed the biometric matcher utilizing a Trojan horse program. Biometric cryptosystems that work in the key generation/binding modes are more secure but hard to perform due to large intra-class differences in biometric data, i.e., samples of the same biometric feature of a user acquired over a period of time can vary substantially.

5.9.2 Bio-Cryptosystem

A biometrics system considers the physical or personal identification of characteristics for the verification, identity of a human being. The functions of biometric systems are codification, measuring and determining of the unique characteristics of individuals with one indeed recorded. In modern years there has been quick growth in the usage of biometrics for user authentication applications because biometric depend on authentication provides different advantages over possession and knowledge based methodologies. Common biometric systems are Uniqueness in human's biometric is a scale of the differences or variations in the biometric model between the worldwide populations. Biometric cryptosystems merge cryptography and biometrics to interest from the strengths of both fields. In such systems, while cryptography supplies adjustable and high security levels, biometrics brings in non-repudiation and the want to carry tokens or remember passwords etc. In biometric cryptosystems, a cryptographic key is generated from the biometric template of a user stored in the database in this a way that the key cannot be detected without a successful biometric authentication. An example, using fingerprint patterns because it is constant during person's life time .

5.9.2.1 Cryptographic Keys in Biometric Cryptosystems

A cryptographic keys, in biometric cryptosystems is generated from the biometric template of a user stored in the database in this way that the key cannot be detected without a succeeded biometric authentication. Cloud networking is linked the idea of cloud computing, in which center computing resources are shared for clients or customers. In cloud networking, the network can be shared plus the computing resources. It has played a direction of pushing more network management functions into the cloud, as well that fewer customer devices are required to manage the network, Cloud networking is a form of Software Defined Networking (SDN) technology, in which groups of access devices and networking switches can deployed via the wide area such as virtual resources, shared. Another terms that depict this shift involve Software-Defined Cloud WAN and WAN (SD-WAN) [126].

5.10 Advantages of Biometrics on the Cloud

Using biometrics to the cloud enables cloud-enhanced technologies and abilities to be assimilated on the full biometrics infrastructure of a service provider. Infrastructure contains virtual servers combining storage components and biometrics template databases, networking other types of processing and automation wanted to identify and verify transactions. The only hardware component the service or host provider requests is to develop or purchase a biometrics capture device (i.e., fingerprint and retina scanner, or vein pattern recognition device). A biometrics business hosted on a cloud-based model boosts a wide range of biometrics technologies and applications.

5.11 Disadvantages of Biometric technology in Cloud:

1) privacy rights and Legal can turn dangerous issues.
2) Cloud resources require to be scalable on demand.
3) Changes in biometric business methods.

Another issue is about acceptance of Biometric technology in the geographical region. In developing countries, this admission rate is quick. But in the developed countries like USA, this rate is lazy. This will energize the modeling Biometrics in Cloud environment.

6. Overview of the Proposed System

The proposed ITS system for Learning Cloud Network Security Based on Biometrics Cryptography bind artificial intelligence and education, which achieves many aspirations. One is matching the special needs of each student, afford various techniques of the material and the user interaction. The system adapts its module according to student's responses. The student's privacy is achieved including level of difficulty reached, score obtained. The questions, which are posed to the learner are chosen randomly from the system on the level reached.

6.1 Authoring Language Used

The researcher used the Intelligent Tutoring System Builder (ITSB) tool, this tool created and developed by using Delphi Embarcadero XE8, 2015; ITSB authoring tool support English and Arabic languages, and consist of two systems in one application: The first Dedicated to with teacher system where it authorize the teachers to add course subjects, questions and answers. The second system Dedicated to the student system where it allows the student to study course subjects and solve exercises.

6.2 Architecture of the proposed ITSCSBC system

A typical ITS have four fundamental modules: Cognitive Module, Student Module, Pedagogical Module and Communication Module. The proposed ITSCSBC system uses the typical architecture of ITS. The proposed ITSCSBC system used the Intelligent Tutoring System Builder (ITSB) programming language, which was developed by Prof. Dr. Samy S. Abu Naser using Delphi Language .

6.2.1 Cognitive Module

The Cognitive Module comprises information about Cloud Network Security Based on Biometrics Cryptography to illustrate the course; intelligent tutoring system utilizes a Cognitive Module to solve problems or solutions cases. The Cognitive Module adds the course format in a systematic way. The course may contain parts, such as division, sub division and topic. These parts are kept in the Cognitive Module with all the items and resources that is necessary to tutor a user.

The module displays the subjects and the learning in a simple way and it products a lot of problems for every lesson taking into consideration individual differences. When a student reply to the problem, determines if correct or wrong, moreover it assess the student. The Cognitive Module presented lessons, its arrangement and a scope of components. The subjects enveloped in this ITSCSBC as follows:

Introduction.
Fundamentals
What Is Cloud Computing
What Cloud Computing Isn't
Essential Characteristics
Architectural Influences
Utility and Enterprise Grid Computing
Autonomic Computing.
Service Consolidation
Horizontal Scaling
Web Services
High-Scalability Architecture
Cloud Computing Architecture
Cloud Delivery Models
Cloud Software as a Service
Cloud Platform as a Service
Cloud Infrastructure as a Service.
Cloud Deployment Models
Public Clouds
Community Clouds
Private Clouds
Hybrid Clouds
Alternative Deployment Models
The Jericho Cloud Cube Model
Expected Benefits
Flexibility and Resiliency
Reduced Costs
Centralization of Data Storage
Reduced Time to Deployment
Cloud Computing Security
Cloud Computing Software Security Fundamentals
Cloud Information Security Objectives
Confidentiality- Integrity- Availability
Cloud Security Services
Relevant Cloud Security Design Principles
Secure Cloud Software Requirements
Approaches to Cloud Software Requirements
A Resource Perspective on Cloud Software Security
Cloud Security Policy Implementation
Decomposing Critical Security Issues into Secure Cloud
NIST 33 Security Principles
Testing for Security Quality Assurance
Conformance Testing
Performance Testing
Security Testing
Cloud Penetration Testing
Legal and Ethical Implications
The Three Pre -Test Phases
Penetration Testing Tools and Techniques
SQL Injection Attack
Regression Testing
Cloud Computing and Business Continuity Planning/Disaster Recovery
General Principles and Practices
Business Continuity Planning
Using the Cloud for BCP
Cloud Computing Risk Issues
The CIA Triad
Other Important Concepts
Threats to Infrastructure, Data, and Access Control
Common Threats and Vulnerabilities
Computer Security and Incident Response Teams
Layered Security and IDS
Data Deduplication
Software-Based Protection
Hardware Protection
Encryption and Key Management
Cryptography
Definition of Cloud cryptography
Cloud cryptography Challenges
Benefits of Cloud cryptography
Cloud Cryptography and Security
Cloud Cryptography and Crypto Management
Biometrics
Benefits of Biometrics on the Cloud

Efficient Cryptographic Key Generation using Biometrics
Bio cryptosystem
Cloud Computing Components
Cloud Service Providers Examples

6.2.2 Student Module

The Student Module is crossing with the Cognitive Module. It features subjective and influencing conditions of the student in respect to his development as the learning movement progresses. As the student advance well ordered through the critical thinking process, the wise mentoring system includes itself in module following procedure. Whenever there is any deviation from the predefined module, the astute mentoring system stamps it as a blunder. Each new student must have his own account to have a profile where it enables the student to think about course subject and do the exercises. The profile has data about the student, for example, date of last visit, login date, student number, student name, current score, and general score. The present score speaks to student score for each level. The general score speaks to student for all levels. Student Module stores insights about the student's present critical thinking state and long haul information advance, fundamental for adjusting the material to the student's qualities (characteristics).

The most popular classifications of student's attributes are thought about:

1. Personal information (name, ID, email ...).
2. Performance information - the student's intellectual and individual attributes, and in addition other general long haul qualities.
3. Overlay information - the present level of dominance of Cloud Network Security Based on Biometrics Cryptography identified with the comparing components in the area module. The current ITS for Cloud Network Security Based on Biometrics Cryptography has two main interfaces: student interface and teacher interface.

Configuration Pattern bit by bit brings different attributes into the Student Module in view of the assessed student's knowledge, for example, experience level, degree of mastery, education style, etc. In the Student Module Attribute values are calculated by implementing a devoted group of rules and simple procedures from Pedagogic Module. The values are adjusted during the session. At the close of each session, the system memorizes the Student Module as report. Whenever the student sign onto the system, the data stored report record are utilized to set the Student Module.

6.2.3 Pedagogical Module

This module is presented the essence of the whole system; it administers all the Procedures and tasks in system. It has been observed that students are having difficulties in understanding Cloud Network Security Based on Biometrics Cryptography. To overcome this distress, an Intelligent Tutoring System for learning Cloud Network Security Based on Biometrics Cryptography called ITSCSBC have been developed to students registered in Advanced Topics in Information Security in the faculty of Engineering and Information Technology at Al-Azhar University in Gaza. It works like a coordinator that administer, controls, monitors the functionality of the system. Pedagogic Module adapts according to student's responses. During this module, the student can answer questions on the first level, and if he gains **75%** score or more, he can shift to the second level. But if he brings low scores less than **50**%, he iterates the exam at the same level (as shown in Figure 5) . The Pedagogic Module works like learning strategies or academic outlines. This module needs information on the points given in the student's interaction. Depending on these facts, the Pedagogic Module can generate tutorial procedure early interaction activities. But the system must to realize what the right method or how to display the same work for various students that they may have various skills, cognitive reasoning. ITSCSBC by degrees introduces students to the concept of Cloud Network Security Based on Biometrics Cryptography and automatically generates exercises for the students to resolve.

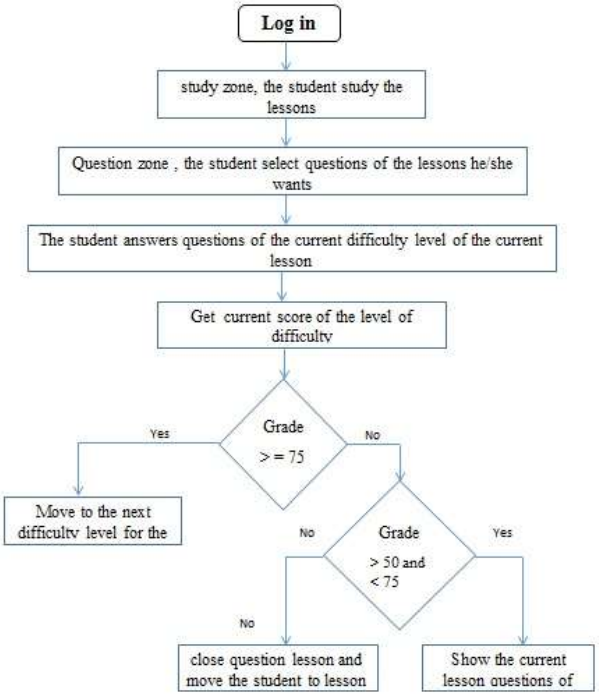


Figure 8 : Pedagogical Module adaption to user level

6.4.4 Communication Module

This is the Interactive interface of the ITSCSBC. It amalgamates all types of information wanted to interact with student, out of shape, text, graphics, keyboard, mouse-driven menus, multimedia, etc. Main factors for user-acceptance are user-friendly and display. Login screen for ITSCSBC showed in, Figure 9. The current ITS for Cloud Network Security Based on Biometrics Cryptography has two main interfaces: teacher interface and student interface.

1- Teacher Interface

Figure 9 shows the teacher login interface. The teacher interfaces includes four parts to build the Student Module and Cognitive Module (as in Figure 10).

The first interface is to add examples and lessons with the capability to supply video, sound, and pictures with lessons to help and simplify the learning of students(as in Figure 11).

The second interface is to add questions and answers with the capability of adding video, picture and hints to simplify the questions answer, and join a level of difficulty for each question(as in Figure 12).

The third interface is to modify lessons and examples with the capability of adding video, picture (as in Figure 13).

The fourth interface to adjust the background color, font, and size, for system components (as in Figure 14), furthermore build basic data about the student and system (as in Figure 15) and Figure 16 shows the interface for adding constants of the system. Admin lessons and examples interface shows in Figure 17 and Figure 18.

2- The Student Interface

Conveys all the commands of teaching process, these commands differs with user's performance level.

Figure 19 shows the user login interface. Figures: 20, 21, 22, 23, 24, 25, 26, and 27 shows the different snapshots of the student screens.

6.4.2 Screen Captures

A screenshot of the student's interface is appears in 20, and 18. The student Interfaces has been prepared for the student to interact with the system out of which shows exams for each lesson. The student selects a lesson from the menu of lessons or examples (as in Figure 20, Figure 21 and Figure 22), check answering shows in Figure 23, and hints shows in Figure 24; the system shows the first difficulty level of the exam questions randomly (as in Figure 25). If the student finished all questions correctly on the first level, the system moves the student to the following level of difficulty automatically (as in Figure 25), else Figure 26 appeared. The interface and responses are fundamental to the process of adaptation of the system with the student. So, the evolution in the adaptation process depend on it (as in Figure 27).

These are some screen samples for the proposed ITSCSBC system.

Figure 9 : Admin login screen

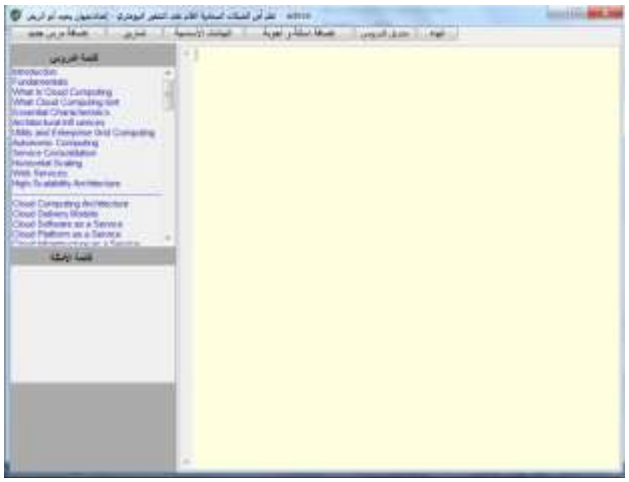


Figure 10 : Admin interface

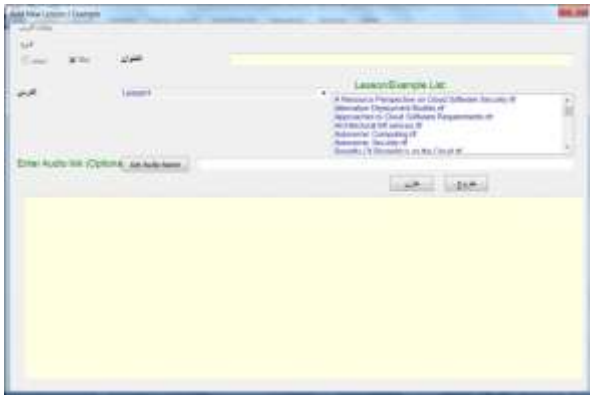


Figure 11 : Interface for adding Lessons and Example

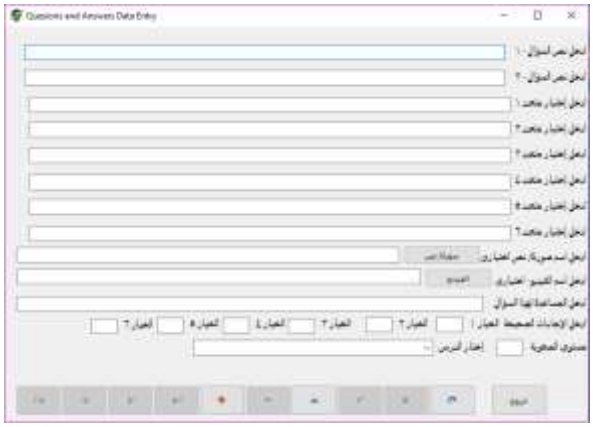


Figure 12 : Interface for adding questions and answers

Figure 13 : Interface for modification Lessons

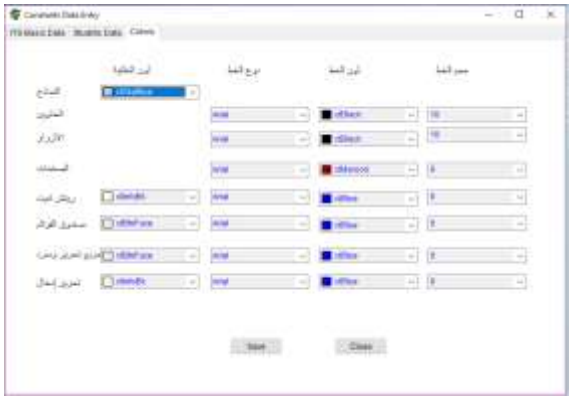


Figure 14 : Interface for modifying Fonts of all screens of the system

Figure 15 : Interface for ITSCSBC Basic Data

Figure 16 : Interface for adding constants of the system

Figure 17 : Admin lessons interface

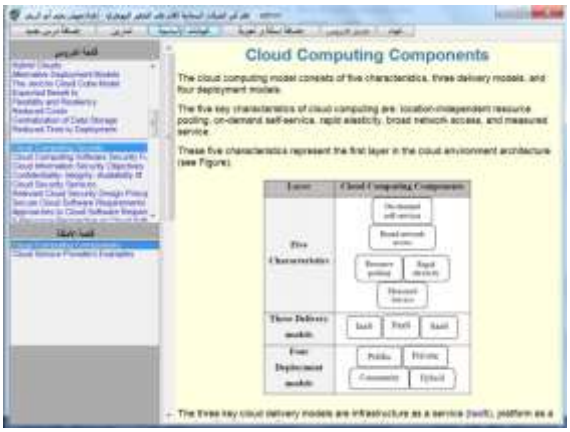


Figure 18: Admin lessons and examples interface

Figure 19 : Student login screen

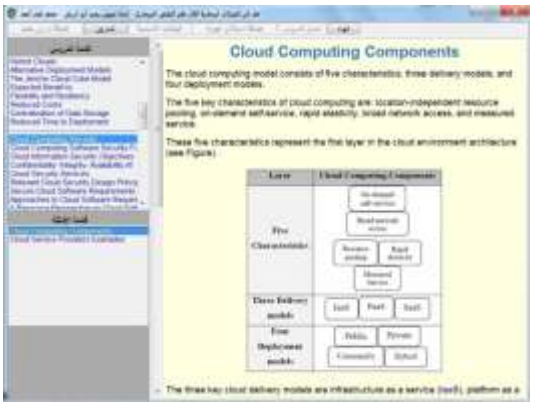


Figure 20 : Student lessons and examples interface

Figure 21 : Shows Student lessons and examples interface supported by using video.

Figure 22 : Student Exercises interface

Figure 23 : check answering

Figure 24 : Hint and check answering

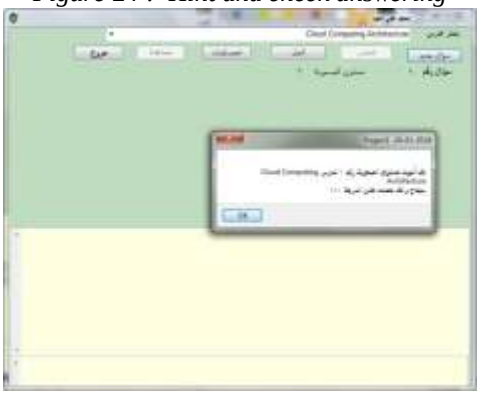


Figure 25 : The result is good

Figure 26 : The result is not good

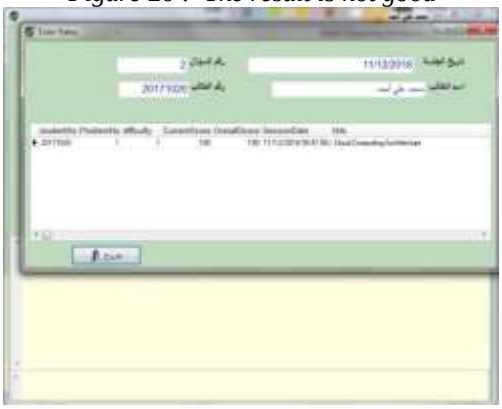


Figure 27 : statistical analysis

7. System Evaluation

An evaluation was done to test the ITSCSBC intelligent tutoring system. The evaluation of the ITSCSBC intelligent tutoring system revealed a number of positive outcomes, including: the efficiency, effectiveness and user satisfaction with the performance of tasks done using the application. The usability evaluation is a vital part of the system development process, and a set of questions has been developed to evaluate the ITSCSBC intelligent tutoring system by people concerned with learning about the efficacy of using an Intelligent Tutoring System in security and computer science Knowledge. The proposed ITSCSBC intelligent tutoring system has been divided into two groups of students and teachers who are specialists in the field. The first group contain of six specialized teachers in computer science. The second group consists of sixteen the students enrolled in Advanced Topics in Information Security in the faculty of Engineering and Information Technology at Al-Azhar University in Gaza. The questionnaire was prepared by the researcher and approved by his supervisors. Both groups were demanded to fill the questionnaire about it and evaluate the proposed ITSCSBC intelligent tutoring system. The results of the questionnaire of the specialized teachers in computer science are shown in Table 7 and Figure 28; moreover, the results of the questionnaire of the master students enrolled in Advanced Topics in Information Security in the faculty of Engineering and Information Technology at Al-Azhar University in Gaza is shown in Table 8 and Figure 29. The results of both groups were as follows

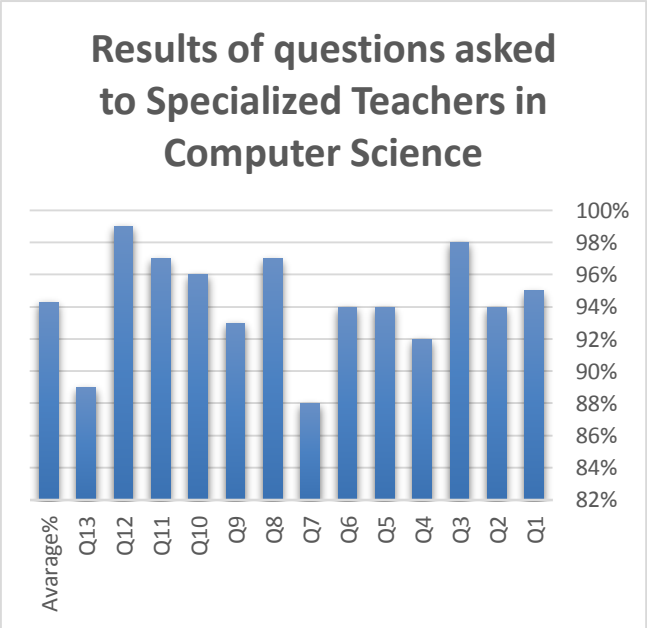
7.1 Results of teachers group

Table 7 outlines each question and its average percentage. Figure 28 shows a bar chart of each question and its percentage.

Table 7 Results of questions asked to Specialized Teachers in Computer Science

S.N.	Question	Average%
1	ITS system easy to use.	95%
2	ITS system is pleasant.	94%
3	ITS system is very useful.	98%
4	ITS system questions are suitable for students.	92%
5	Questions in ITS System Suitable for course Advanced Topics in Information Security.	94%
6	The topic that ITS System explains is important.	94%
7	Using the ITS System enriches the student from attending lectures.	88%
8	ITS system is of high quality.	97%
9	ITS system helps to understand more scientific subject.	93%
10	Using the ITS System makes learning the course easier.	96%
11	I recommend using the ITS System for other courses.	97%
12	The ITS System can be used as an aid tool in the course.	99%
13	The ITS system needs a lot of improvements.	89%
Overall average satisfaction		94.3%

Figure 28 :The results were



obtained by the Specialized Teachers in Computer Science

7.2 Results of Students in group

Table 8 shows each question and its average percentage. Figure 29 shows a bar chart of each question and its percentage.

Table 8: Results of questions asked to Master Students in Computer Science

S.N.	Question	Average%
1	ITS system easy to use.	98%
2	ITS system is pleasant.	96%
3	ITS system is very useful.	93%
4	ITS system questions are suitable for students.	94%
5	Questions in ITS System Suitable for course Advanced Topics in Information Security.	95%
6	The topic that ITS System explains is important.	98%
7	Using the ITS System enriches the student from attending lectures.	91%
8	ITS system is of high quality.	94%

0	ITS system helps to understand more scientific subject.	95%
10	Using the ITS System makes learning the course easier.	94%
11	I recommend using the ITS System for other courses.	97%
12	The ITS System can be used as an aid tool in the course.	100%
13	The ITS system needs a lot of improvements.	88%
Overall average satisfaction		94.5%

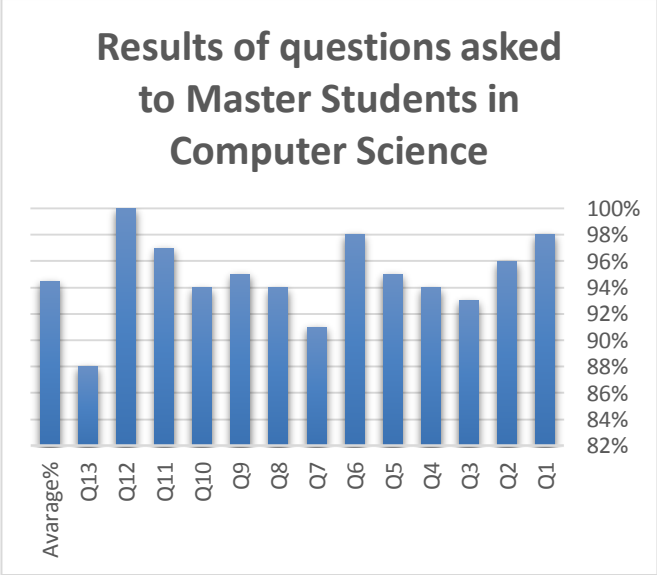


Figure 29 : The results were obtained by the Master Students in Computer Science

In evaluating the proposed ITS system, evaluators were asked to use the proposed ITS system. Next that, they were demanded to give their feedback about the proposed ITS system through filling the questionnaire which consisted of the thirteen questions above mentioned.

In this method, efficiency, effectiveness and satisfaction of the proposed ITS system were measured as shown in the above figures. The evaluation results were very affirmative.

8. CONCLUSION

Many students face a lot of problems in understanding most subject in security, especially in a cloud and network security mistakes in front of the teacher. To defeat these problems an intelligent tutoring system for learning Cloud Network Security Based on Biometrics Cryptography system was proposed. This system provides direct, personalized training and feedback to the student's intendant of human teachers. The system was tested by two groups of users, one for teachers second for students and they were asked to run the system, then evaluate its simplicity, the material and the user interface. They reported that the system overcomes most of the problems in teaching Cloud Network Security Based on Biometrics Cryptography system in the traditional learning and mention that it achieves adaptation upon the needs of each student. In this thesis of Learning Cloud Network Security Based on Biometrics Cryptography system so that the system can run on heterogeneous platforms. The work is dedicated to those the students registered in Advanced Topics in Information Security in the faculty of Engineering and Information Technology at Al-Azhar University in Gaza, It involves four modules mainly Cognitive Module, Student Module, Pedagogic Module, Interface Module. The student Module of the Learning Cloud Network Security Based on Biometrics Cryptography. ITS is functionally fully decoupled from the other components of the system. This approach to student modeling uses a combination of stereotype and overlay techniques. Its main advantage compared to other similar modules is a universal approach to module creation. The approach is not strictly related to design patterns as the domain of teaching/learning. It can be applied to ITS in any domain without changes or with a few changes, depending on the requirements of the Pedagogic Module. Curriculum sequencing is based on execution of instructional plan generated based on student knowledge of domain matter. Course units are generated dynamically from the Cognitive Module by using adaptive presentation templates. In module maintenance. The tutoring system is developed and implemented to increase and/or enhance the skills to the students in the adopted domain. The system is briefly explaining the chosen domain. The system supports the explanation process using the multimedia facilities such as images, sound, animation and text as well.

The system involves also the question analysis as well as the domain knowledge expert. The knowledge of the Expert Module is important for presenting the correct answer. The system also is supported by a graphical user interface to ease the interaction with the students. This work is considered the prototype as it can be scaled up to cover other subject curricula.

8.2 Future Work

With the existing methodology of evolving ITS, it is clear that tutoring experiences were hard- coded into individual applications and, the prototypes of ITS have been designed independently, until the present. This work as prototype as it can be pushed up to include other subject curricula. There are different trends in future development and future research of the model design system:

1 - Development of a case-based generator of new problems for student.

2 - Development of a graphical authoring tool for Cognitive Module maintenance.

3 - Another intelligent tutoring systems be designed for other courses.

4- We recommend a comprehensive evaluation of the system to be carried out next time the course is offered.

5 - Eventually, these systems must be developed as general-purpose software tools such as word processors and spreadsheets.

6 - In this way, they can be independent from the domain. With the viewpoint of mathematics education the graduate level, ITS should be capable of proving theorems.

For future work, I am intending to convert the ITS system into mobile applications, and expand the system to applicable fields beyond the domain of learning, for example, companies guidance, environmental awareness, and health.

REFERENCES

[1] Hilles, M. M., & Abu Naser, S. S. (2017). Knowledge-based Intelligent Tutoring System for Teaching Mongo Database. EUROPEAN ACADEMIC RESEARCH, 6(10), 8783-8794.

[2] Naser, S. S. A. (2016). ITSB: An Intelligent Tutoring System Authoring Tool. Journal of Scientific and Engineering Research, 3(5), 63-71.

[3] Hamed, M. A., & Abu Naser, S. S. (2017). An intelligent tutoring system for teaching the 7 characteristics for living things. International Journal of Advanced Research and Development, 2(1), 31-45.

[4] Martin, B. I. (2002). Intelligent Tutoring Systems: The practical implementation of constraint-based modelling.

[5] Conole, G., & Oliver, M. (2006). Contemporary perspectives in e-learning research.

[6] Evens, M., & Michael, J. (2006). One-on-one tutoring by humans and computers. Psychology Press (pp. 371-372).

[7] Cercone, N., & McCalla, G. (Eds.). (2012). The knowledge frontier: essays in the representation of knowledge. Springer Science & Business Media (pp. 341-344).

[8] West, S. (1990). Co-author of Science Safety Checklist. Science Lab Safety. The Science Teacher 19(2), (pp. 20-24).

[9] Carey, J. M. (Ed.). (1988). Human factors in management information systems (Vol. 1), (pp. 64-80).

[10] Herrmann, D. J., McEvoy, C., Hertzog, C., Hertel, P., & Johnson, M. K. (2014). Basic and Applied Memory Research: Volume 1: Theory in Context; Volume 2: Practical Applications. Psychology Press (pp. 374).

[11] Meyer, T., Steuck, K., Miller, T., Pesthy, C., & Kretschmer, M. (1999, March). Teaching Scientific Inquiry Skill with an Intelligent Tutoring System. Proceedings of the Mathematics/Science Education & Technology, (pp. 492 – 495), San Antonio, TX.

[12] Aleven, V., Mclaren, B., Roll, I., & Koedinger, K. (2006). Toward meta-cognitive tutoring: A model of help seeking with a Cognitive Tutor. International Journal of Artificial Intelligence in Education, 16(2), (pp.101-128).

[13] Ohlsson, S. (1996). Learning from performance errors. Psychological review, 103(2), (pp. 241).

[14] Devedzic, V., & Harrer, A. (2005). Software patterns in ITS architectures. International Journal of Artificial Intelligence in Education, 15(2), (pp. 63-94).

[15] AL-AQBI, A. T. Q. (2017). Intelligent Tutoring System Effects on the Learning Process. M.A. thesis, University of Technology. Wright State University.

[16] Paiva, A., Self, J., & Hartley, R. (1995, August). Externalising learner models. In Proceedings of World Conference on Artificial Intelligence in Education (pp. 509-516).

[17] Nkambou, R., Bourdeau, J., & Mizoguchi, R. (2010). Introduction: what are intelligent tutoring systems, and why this book?. In Advances in Intelligent Tutoring Systems (pp. 1-12). Springer, Berlin, Heidelberg.

[18] Corbett, A. (2002). Cognitive tutor algebra I: Adaptive student modeling in widespread classroom use. In Technology and assessment: Thinking ahead. proceedings from a workshop (pp. 50-62).

[19] Lynch, C., Ashley, K., Aleven, V., & Pinkwart, N. (2006, June). Defining ill-defined domains; a literature survey. In Proceedings of the workshop on intelligent tutoring systems for ill-defined domains at the 8th international conference on intelligent tutoring systems (pp. 1-10).

[20] Jeremic, Z., & Devedzic, V. (2004, August). Design pattern its: Student model implementation. In Advanced Learning Technologies, 2004. Proceedings. IEEE International Conference on (pp. 864-865). IEEE.

[21] Tsybenko, Y. (1995). Device Models. In Student Modeling. In The Proceedings of International Conference on Artificial Intelligence in Education, edited by J. Greer (pp. 525-532).

[22] Viccari, R. M. (Ed.). (2008). Agent-based tutoring systems by cognitive and affective modeling. IGI Global, (pp. 300-303).

[23] Woolf, B. (1988). Intelligent tutoring systems: a survey. In Exploring artificial intelligence (pp. 1-43).

[24] Tsybenko, Y. (1995). Device Models. In Student Modeling. In The Proceedings of International Conference on Artificial Intelligence in Education, edited by J. Greer (pp. 525-532).

[25] Stauffer, K. (1996). Student modeling and web-based learning systems. Short research project, Athabasca University.

[26] Harp, S. A., Samad, T., & Villano, M. (1995). Modeling student knowledge with self-organizing feature maps. IEEE transactions on systems, man, and cybernetics, 25(5), (pp. 727-737).

[27] Mathews, M. M. (2012). A Framework for Multiple Adaptable Pedagogical Strategies in Intelligent Tutoring Systems. Ph.D. thesis, University of Canterbury.

[28] Hiesel, J. C. (1993). An approach to the analysis and deisgn of an intelligent tutoring system using an object-oriented methodology. Thesis. Rochester Institute of Technology.

[29] Dillenbourg, P., & Self, J. (1992). A framework for learner modelling. Interactive Learning Environments, 2(2), (pp. 111-137).

[30] Padayachee, I. (2002, June). Intelligent tutoring systems: Architecture and characteristics. In Proceedings of the 32nd Annual SACLA Conference (pp. 1-8).

[31] Benefits Of Tutoring: https://www.oxfordlearning.com (Accessed on; December 2018).

[32] AbuEl-Reesh, J. Y., & Abu-Naser, S. S. (2018). An Intelligent Tutoring System for Learning Classical Cryptography Algorithms (CCAITS). International Journal of Academic and Applied Research (IJAAR), 2(2), 1-11.

[33] Marouf, A., Yousef, M. K. A., Mukhaimer, M. N., & Abu-Naser, S. S. (2018). AnIntelligent Tutoring System for Learning Introduction to Computer Science. International Journal of Academic Multidisciplinary Research (IJAMR), 2(2), 1-8.

[34] Albatish, I., Mosa, M. J., & Abu-Naser, S. S. (2018). ARDUINO Tutor: An Intelligent Tutoring System for Training on ARDUINO. International Journal of Engineering and Information Systems (IJEAIS), 2(1), 236-245.

[35] Al-Bastami, B. G., & Abu Naser, S. S. (2017). Design and Development of an Intelligent Tutoring System for C# Language. EUROPEAN ACADEMIC RESEARCH, 6(10), 8795.

[36] Appleton, J. (2017). Introducing intelligent exercises to support web application programming students.

[37] Almurshidi, S. H., & Abu Naser, S. S. (2017). Design and Development of Diabetes Intelligent Tutoring System. EUROPEAN ACADEMIC RESEARCH, 6(9), 8117-8128.
[38] Al-Hanjori, M. M., Shaath, M. Z., & Abu Naser, S. S. (2017). Learning computer networks using intelligent tutoring system. International Journal of Advanced Research and Development(2), 1.
[39] Abu Hasanein, H. A., & Abu Naser, S. S. (2017). An intelligent tutoring system for cloud computing. International Journal of Academic Research and Development, 2(1), 76-80.
[40] Elnajjar, A. E. A., & Abu Naser, S. S. (2017). DES-Tutor: An Intelligent Tutoring System for Teaching DES Information Security Algorithm. International Journal of Advanced Research and Development, 2(1), 69-73.
[41] Aldahdooh, R., & Abu Naser, S. S. (2017). Development and Evaluation of the Oracle Intelligent Tutoring System (OITS). EUROPEAN ACADEMIC RESEARCH, 6(10), 8711-8721.
[42] Akkila, A. N., & Abu-Naser, S. S. (2018). Rules of Tajweed the Holy Quran Intelligent Tutoring System. International Journal of Academic Pedagogical Research (IJAPR), 2(3), 7-20.
[43] Weber, G., & Brusilovsky, P. (2016). ELM-ART–An interactive and intelligent web-based electronic textbook. International Journal of Artificial Intelligence in Education, 26(1), (pp. 72-81).
[44] Alhabbash, M. I., Mahdi, A. O., & Abu Naser, S. S. (2016). An Intelligent Tutoring System for Teaching Grammar English Tenses. EUROPEAN ACADEMIC RESEARCH, 6(9), 7743-7757.
[45] Ade-Ibijola, A. O. (2016). Automatic novice program comprehension for semantic bug detection (Doctoral dissertation).
[46] Umbarkar, P. M., & Borkar, N. R. (2016). Cloud Computing Data Security: A Review. International Journal on Recent and Innovation Trends in Computing and Communication, 4(4), (pp. 262-265).
[47] What is Cloud Networking or Cloud Based Networking: https://www.sdxcentral.com (Accessed on; August 2018) .
[48] Rittinghouse, J. W., & Ransome, J. F. (2016). Cloud computing: implementation, management, and security. CRC press. management & security, Ed. Taylor & Francis Group, (pp.27-29).
[49] Mell, P., & Grance, T. (September 2011). The NIST definition of cloud computing. National Institute of Standards and Technology, (pp. 800-145).
[50] Fehling, C., Leymann, F., Retter, R., Schupeck, W., & Arbitter, P. (2014). Cloud computing patterns: fundamentals to design, build, and manage cloud applications. Springer Science & Business Media.
[51] Espadas, J., Concha, D., & Molina, A. (2008, October). Application development over software-as-a-service platforms. In Software Engineering Advances, 2008. ICSEA'08. The Third International Conference on (pp. 97-104). IEEE.
[52] Lenk, A., Klems, M., Nimis, J., Tai, S., & Sandholm, T. (2009, May). What's inside the Cloud? An architectural map of the Cloud landscape. In Proceedings of the 2009 ICSE Workshop on Software Engineering Challenges of Cloud Computing (pp. 23-31). IEEE Computer Society.
[53] Gass, O., Meth, H., & Maedche, A. (2014). PaaS characteristics for productive software development: an evaluation framework. IEEE Internet Computing, 18(1), (pp. 56-64).
[54] Mell, P., & Grance, T. (2009). The NIST definition of cloud computing. National institute of standards and technology, 53(6), (pp. 50).
[55] Security as a service: https://en.wikipedia.org/wiki/Security_as_a_service (Accessed on; December 2018)
[56] So, K. (2011). Cloud computing security issues and challenges. International Journal of Computer Networks, 3(5), 247-55.
[57] Hofmann, P., & Woods, D. (2010). Cloud computing: the limits of public clouds for business applications. IEEE Internet Computing, 14(6), (pp. 90-93).
[58] Advantages and Disadvantages of Cloud Computing: https://cloudacademy.com (Accessed on; November 2018).
[59] Fox, A., Griffith, R., Joseph, A., Katz, R., Konwinski, A., Lee, G., ... & Stoica, I. (2009). Above the clouds: A berkeley view of cloud computing. Dept. Electrical Eng. and Comput. Sciences, University of California, Berkeley, Rep. UCB/EECS, 28(13), 2009.
[60] Nayak, S., & Yassir, A. (2012). Cloud computing as an emerging paradigm. International Journal of Computer Science and Network Security, 12(1), (pp. 61-65).
[61] Ziyad, S., & Rehman, S. (2014). Critical review of authentication mechanisms in cloud computing. International Journal of Computer Science Issues (IJCSI), 11(3), (pp. 145).
[62] Cybersecurity: https://searchsecurity.techtarget.com/definition/cybersecurity (Accessed on; October 2018)
[63] Cyber security standards: https://en.wikipedia.org (Accessed on; December 2018)
[64] Sen, J., & Sengupta, I. (2005, December). Autonomous agent based distributed fault-tolerant intrusion detection system. In International Conference on Distributed Computing and Internet Technology (pp. 125-131). Springer, Berlin, Heidelberg.
[65] Cloud Computing and Security- A Natural Match: http://www.trustedcomputinggroup.org (Accessed on; December 2018).
[66] Kar, A. K., & Dey, S. K. Cryptography in the Banking Industry. Frontiers, 1(1), (pp. 1-7).
[67] Sabhanayagam, T., Venkatesan, V. P., & Senthamaraikannan, K. (2018). A Comprehensive Survey on Various Biometric Systems. International Journal of Applied Engineering Research, 13(5), (pp. 2276-2297).
[68] Bogdan Groza, Introducere în Criptografie-Funcţii criptografice, Fundamente matematiceşi computaţionale, Publisher Politehnica, 2012.
[69] Diffie–Hellman key exchange: http://en.wikipedia.org/wiki (Accessed on; November 2018).
[70] Hardjono, T., & Dondeti, L. R. (2005). Security in Wireless LANS and MANS (Artech House Computer Security). Artech House Inc.
[71] Atulkhate, Cryptography and Network Security, 2nd Ed,‖ Tata Mcgraw hill, 2009, PP. 87-2004.
[72] Gaddam, S. V., & Lal, M. (2010). Efficient Cancelable Biometric Key Generation Scheme for Cryptography. IJ Network Security, 11(2), (pp. 61-69).
[73] Advanced Encryption Standard. (http://en.wikipedia.org/wiki/Advanced Encryption Standard)
[74] Menezes, P. (1997). van Oorschot, and S. Vanstone. Handbook of applied cryptography. pp. 180.

[75] Tistarelli, M., & Nixon, M. S. (Eds.). (2009). Advances in Biometrics: Third International Conferences, ICB 2009, Alghero, Italy, June 2-5, 2009, Proceedings (Vol. 5558). Springer.
[76] Rittinghouse, J. W., & Ransome, J. F. (2016). Cloud computing: implementation, management, and security. CRC press.
[77] Al Rekhawi, H. A., & Abu Naser, S. S. (2018). An Intelligent Tutoring System for Learning Android Applications Ui Development. International Journal of Engineering and Information Systems (IJEAIS), 2(1), 1-14.
[78] Alawar, M. W., & Abu Naser, S. S. (2017). CSS-Tutor: An intelligent tutoring system for CSS and HTML. International Journal of Academic Research and Development, 2(1), 94-98.
[79] Mahdi, A. O., Alhabbash, M. I., & Abu Naser, S. S. (2016). An intelligent tutoring system for teaching advanced topics in information security. World Wide Journal of Multidisciplinary Research and Development, 2(12), 1-9.
[80] Abu-Naser, S., Ahmed, A., Al-Masri, N., Deeb, A., Moshtaha, E., &AbuLamdy, M. (2011). An intelligent tutoring system for learning java objects. International Journal of Artificial Intelligence and Applications (IJAIA), 2(2).
[81] Petrovica, Sintija&Anohina-Naumeca, Alla&Ekenel, Hazım. (2017). Emotion Recognition in Affective Tutoring Systems: Collection of Ground-truth Data. Procedia Computer Science. 104. 437-444. 10.1016/j.procs.2017.01.157.
[82] Yanjin Long and Vincent Aleven, Mastery-Oriented Shared Student/System Control Over Problem Selection in a Linear Equation Tutor, Springer International Publishing Switzerland 2016, A. Micarelli et al. (Eds.): ITS 2016, LNCS 9684, pp. 90–100, 2016. DOI: 10.1007/978-3-319-39583-8_9
[83] Hoang Nam Ho , Mourad Rabah , Samuel Nowakowski , and Pascal Estraillier, Toward a Trace-Based PROMETHEE II Method to Answer"What Can Teachers Do?" in Online Distance Learning Applications, Springer International Publishing Switzerland 2016, A. Micarelli et al. (Eds.): ITS 2016, LNCS 9684, pp. 480–484, 2016. DOI: 10.1007/978-3-319-39583-8.
[84] Abu Ghali, M., Abu Ayyad, A., Abu-Naser, S., & Abu Laban, M. (2018). An Intelligent Tutoring System for Teaching English Grammar. International Journal of Academic Engineering Research (IJAER), 2(2), 1-6.
[85] Abu Naser, S. S. (2006). Intelligent tutoring system for teaching database to sophomore students in Gaza and its effect on their performance. Information Technology Journal, 5(5), 916-922.
[86] AbuEloun, N. N., & Abu Naser, S. S. (2017). Mathematics intelligent tutoring system. International Journal of Advanced Scientific Research, 2(1), 11-16.
[87] Abu-Nasser, B. S., & Abu-Naser, S. S. (2018). Cognitive System for Helping Farmers in Diagnosing Watermelon Diseases. International Journal of Academic Information Systems Research (IJAISR), 2(7), 1-7.
[88] Akkila, A. E.-D. N., & Abu Naser, S. S. (2018). ITS-Tutor for Teaching Rules of Tajweed the Holy Quran. Al-Azhar University, Gaza, Palestine.
[89] Abu Naser, S. (2008). JEE-Tutor: An Intelligent Tutoring System for Java Expression Evaluation. Information Technology Journal, Scialert, 7(3), 528-532.
[90] Akkila, A. N., & Abu Naser, S. S. (2017). Teaching the right letter pronunciation in reciting the holy Quran using intelligent tutoring system. International Journal of Advanced Research and Development, 2(1), 64-68.
[91] Abu Naser, S. S., & Sulisel, O. (2000). The effect of using computer aided instruction on performance of 10th grade biology in Gaza. Journal of the College of Education, 4, 9-37.
[92] Abu Naser, S., Sulisel, O., Alexandrescu, A., Anderson, J., Skwarecki, E., Anderson, J., . . . Brusilovsky, P. (2005). Growth and Maturity of Intelligent Tutoring Systems. Information Technology Journal, 7(7), 9-37.
[93] Abu-Naser, S., Kashkash, K., Fayyad, M., Azaab, S., Riley, M., Williamson, M., . . . Maloy, O. (2005). Expert system methodologies and applications-a decade review from 1995 to 2004. Journal of Artificial Intelligence, 1(2), 9-26.
[94] Al Rekhawi, H. A., & Abu-Naser, S. S. (2018). Android Applications UI Development Intelligent Tutoring System. International Journal of Engineering and Information Systems (IJEAIS), 2(1), 1-14.
[95] Abu Naser, S., Al-Dahdooh, R., Mushtaha, A., & El-Naffar, M. (2010). Knowledge management in ESMDA: expert system for medical diagnostic assistance. AIML Journal, 10(1), 31-40.
[96] Al-Ani, I. A. R., Sidek, L. M., Desa, M. M., Basri, N. A., Burns, J., Bhutani, J., . . . Fashokun, A. (2007). Water pollution and its effects on human health in rural areas of Faisalabad. Journal of Environmental Science and Technology, 5(5), 1-17.
[97] Abu Naser, S., & Akkila, A. N. (2008). A Proposed Expert System for Skin Diseases Diagnosis. INSInet Publication. Journal of Applied Sciences Research, 4(12), 1682-1693.
[98] Abu Naser, S., Ahmed, A., Al-Masri, N., & Abu Sultan, Y. (2011). Human Computer Interaction Design of the LP-ITS: Linear Programming Intelligent Tutoring Systems. International Journal of Artificial Intelligence & Applications (IJAIA), 2(3), 60-70.
[99] Abu Naser, S. (2008). An Agent Based Intelligent Tutoring System For Parameter Passing In Java Programming. Journal of Theoretical & Applied Information Technology, 4(7).
[100] Al-Bayed, M. H., & Abu Naser, S. S. (2017). An intelligent tutoring system for health problems related to addiction of video game playing. International Journal of Advanced Scientific Research, 2(1), 4-10.
[101] Al-Bayed, M. H., & Abu-Naser, S. S. (2018). Intelligent Multi-Language Plagiarism Detection System. International Journal of Academic Information Systems Research (IJAISR), 2(3), 19-34.
[102] Abu Naser, S. S. (2001). A comparative study between animated intelligent tutoring systems AITS and video-based intelligent tutoring systems VITS. Al-Aqsa Univ. J, 5(1), 72-96.
[103] Abu Naser, S., Zaqout, I., Ghosh, M. A., Atallah, R., & Alajrami, E. (2015). Predicting Student Performance Using Artificial Neural Network: in the Faculty of Engineering and Information Technology. International Journal of Hybrid Information Technology, 8(2), 221-228.
[104] Abu Naser, S., & El Haddad, I. (2016). An Expert System for Genital Problems in Infants. World Wide Journal of Multidisciplinary Research and Development (WWJMRD), 2(5).
[105] Almurshidi, S. H., & Abu Naser, S. S. (2017). Stomach disease intelligent tutoring system. International Journal of Advanced Research and Development, 2(1), 26-30.

[106] Al-Nakhal, M. A., & Abu Naser, S. S. (2017). Adaptive Intelligent Tutoring System for learning Computer Theory. EUROPEAN ACADEMIC RESEARCH, 6(10), 8770-8782.
[107] Atallah, R. R., & Abu Naser, S. S. (2014). Data mining techniques in higher education an empirical study for the university of Palestine. IJMER, 4(4), 48-52.
[108] Atallah, R. R., & Abu Naser, S. S. (2014). Transformation of E-kanban to BPEL Using Information Retrieval Method For Searching. IOSR Journal of Engineering (IOSRJEN), 4(11).
[109] Bakeer, H., & Abu Naser, S. S. (2017). Photo Copier Maintenance Expert System V. 01 Using SL5 Object Language. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 116-124.
[110] Chen, R.-S., Tsai, C.-H., Abu-Naser, S., Bishop, A., Bishop, C., Arbaugh, J., . . . Trent, B. (2008). Evaluating structural equation models with unobservable variables and measurement error. Information Technology Journal, 10(2), 1055-1060.
[111] El Agha, M. I., Jarghon, A. M., & Abu-Naser, S. S. (2018). SQL Tutor for Novice Students. International Journal of Academic Information Systems Research (IJAISR), 2(2), 1-7.
[112] El Haddad, I. A., & Abu Naser, S. S. (2017). ADO-Tutor: Intelligent Tutoring System for leaning ADO. NET. EUROPEAN ACADEMIC RESEARCH, 6(10), 8810-8821.
[113] Hamed, M. A., Abu-Naser, S. S., & Abualhin, K. S. (2018). Intelligent Tutoring System Effectiveness for Water Knowledge and Awareness. International Journal of Academic Information Systems Research (IJAISR), 2(4), 18-34.
[114] Hasanein, H. A. A., & Abu-Naser, S. S. (2018). Developing Education in Israa University Using Intelligent Tutoring System. International Journal of Academic Pedagogical Research (IJAPR), 2(5), 1-16.
[115] Khella, R. A., & Abu-Naser, S. S. (2018). An Intelligent Tutoring System for Teaching French. International Journal of Academic Multidisciplinary Research (IJAMR), 2(2), 9-13.
[116] Li, D., Ghosh, M. M. A., Atallah, R. R., & Naser, S. S. A. (2016). A Novel Distributed Index Method for Cloud Computing. Issues(360).
[117] Li, L., Chen, N., He, C., Lang, F., Li, H., Wang, H., . . . Gong, P. (2011). Hybrid Quantum-inspired genetic algorithm for extracting association rule in data mining. Information Technology Journal, 12(4), 1437-1441.
[118] Abu Naser, S. S., Baker, J., Cruz, I., Liotta, G., Tamassia, R., Cooper, M., . . . Feldman, M. (2006). Information Visualization. Information Technology Journal, 7(2), pp: 403-404.
[119] Abu Naser, S. S., Atallah, R. R., & Hamo, S. (2015). Building an Ontology in Educational Domain Case Study for the University of Palestine. International Journal of Research in Engineering and Science (IJRES), 3(1), 15-21.
[120] Mosa, M. J., Albatish, I., & Abu-Naser, S. S. (2018). ASP. NET-Tutor: Intelligent Tutoring System for leaning ASP. NET. International Journal of Academic Pedagogical Research (IJAPR), 2(2), 1-8.
[121] Abu Naser, S. S., Anderson, J., Corbett, A., Koedinger, K., Pelletier, R., Beal, C., . . . Soh, L. (2005). Adaptation of Problem Presentation and Feedback in an Intelligent Mathematics Tutor. Information Technology Journal, 5(5), 167-207.
[122] Naser, S. (2009). Evaluating the effectiveness of the CPP-Tutor an intelligent tutoring system for students learning to program in C++. Journal of Applied Sciences Research, 5(1), 109-114.
[123] Abu Naser, S. S. (2012). A Qualitative Study of LP-ITS: Linear Programming Intelligent Tutoring System. International Journal of Computer Science & Information Technology, 4(1), 209.
[124] Ng, S., Wong, C., Lee, T., Lee, F., Abu-Naser, S., El-Hissi, H., . . . James, A. (2010). Ad hoc networks based on rough set distance learning method. Information Technology Journal, 10(9), 239-251.
[125] Abu Naser, S. S. (2008). Developing visualization tool for teaching AI searching algorithms. Information Technology Journal, Scialert, 7(2), 350-355.
[126] Owaied, H. H., Abu-Ara, M. M., Qasem, M. M., Fahmy, H., Douligeris, C., Aha, D., . . . Dillon, T. (2009). Using rules to support case-based reasoning for harmonizing melodies. Journal of Applied Sciences, 11(14), pp: 31-41.
[127] Abu Naser, S. S. (2008). Developing an intelligent tutoring system for students learning to program in C++. Information Technology Journal, 7(7), 1055-1060.
[128] Qwaider, S. R., & Abu-Naser, S. S. (2018). Excel Intelligent Tutoring System. International Journal of Academic Information Systems Research (IJAISR), 2(2), 8-18.
[129] Abu Naser, S. S. (2012). Predicting learners performance using artificial neural networks in linear programming intelligent tutoring system. International Journal of Artificial Intelligence & Applications, 3(2), 65.
[130] Bakeer, H. M. S, & Abu-Naser, S. S. (2019). An Intelligent Tutoring System for Learning TOEFL. International Journal of Academic Pedagogical Research (IJAPR), 2 (12), 9-15.
[131] Al-Shawwa, M. , Alshawwa I. A., & Abu-Naser, S. S. (2019). An Intelligent Tutoring System for Learning Java. International Journal of Academic Information Systems Research (IJAISR), 3(1), 1-6.
[132] Alshawwa, I. A., Al-Shawwa, M., & Abu-Naser, S. S. (2019). An Intelligent Tutoring System for Learning Computer Network CCNA. International Journal of Engineering and Information Systems (IJEAIS), 3(2), 28-36.
[133] Marouf, A., & Abu-Naser, S. S. (2019). Intelligent Tutoring System for Teaching Computer Science I in Al-Azhar University, Gaza. International Journal of Academic and Applied Research (IJAAR), 3 (3), 31-53.