An approach for Schools Management System on the Cloud Computing

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ABSTRACT

The schools management information system plays an essential role for the success of the school management. The main purpose of the management information system at initial steps of its development is to improve the efficiency of the office activities. In school environment it was used to store student and personnel data. The most concern was being focused on data entry and collation, rather than on data transfer or analysis. This paper proposed a framework based on cloud computing that provides detailed and summarized information on the critical areas of the management activities to guide schools administrators in planning and in decision-making. Such information system will be accessible anywhere anytime as data are stored in remote servers that are accessible to users over the internet. Unified Modeling Language (UML) is used in the development of the proposed framework. To evaluate the developed framework, a web based application was developed using the proposed framework, and then some International Organization for Standardization (ISO) qualification metrics were used to evaluate the developed web based application using some selected characteristics. The evaluation results show that the proposed framework is very effective. Through the evaluation, the proposed framework is found to represents a solution to most of the problems mentioned in the previous researches and this implies that the proposed framework can be adopted by schools for more efficient information management and more effective management decisions.

Key words: Cloud-based system, School management information system, Management information system

INTRODUCTION

Computers programs and information systems are seen to have the potential to make a significant contribution to the activities in teaching, and learning, and in schools management. An extensive amount of money that was invested in introduction of computer information systems and communication technology for schools will be considered worthwhile if there is evidence that it has made an equal impact on the performance and the effectiveness of the schools (Condie *et a*l., 2007, Madiha Shah, 2013).

The use of computer programs and information systems as a technology in educational management has rapidly increased due to their efficiency and effectiveness. This technology can solve complex problem pertaining to schools such as allocation problems (e.g., staff allocation, resource allocation, timetabling) and monitoring the school operations. Managers used to spent large amount of time in such problems. The computer information technology can solve these problems in an easy way. It facilitates the decentralization of work tasks and their coordination in an interactive network of communication in real time (Castells, 1996, Madiha Shah, 2013). It also allows for greater flexibility and networking that emphasizes interdependence, interaction, and constant adaptation to an ever-changing environment (Castells, 2001, Madiha Shah, 2013).
The introduction of school management information systems in schools will have a significant positive impact in roles and working styles of managers (Telem, 1999, Kamile DEMİR ,2006). It can help managers to make the right decision in distributing resources, and forming educational methods of future, determining performances of teachers and success of the school (Telem & Buvitski, 1995; Telem, 1991, Kamile DEMİR ,2006).
The school management information systems can also help them to put strategic plans for the future development. It can also be used as a tool to initiate and use educational leadership of the manager (Telem, 1999, Kamile DEMİR, 2006.).

In the Sudan there an almost absence of scientific research related to information technology that assist in the educational process, as each school is working individually and in random attempt to automate the administrative process leading to a lack of harmony between the schools in using information technology. All the management tasks of the schools in Sudan should be transformed from traditional system to computer based information system. The use of such information system should be unified in all the schools of the Sudan.

According to Moore's law, the processing power and the storage technologies have increased significantly, and their price fall each year and this trend is likely to continue. Also the internet access and computing resources are becoming more available and more powerful than ever before. This technology trend lead to the introduction of new technology called cloud computing. In cloud computing the resources can be used through the Internet in an on demand bases (Avram, 2013).

Cloud computing technology can be used to manage schools in the Sudan through one window. The objective of this study is to provide a framework for cloud computing service to serve the Sudanese schools. The adoption of this framework will lead to a reduction of the high cost of traditional system, unify the management systems of schools in one frame according to specific rules and policies and this will leads to an increased efficiency and effectiveness and allow a follow-up and monitoring of the performance of schools through a one window. The study involves development of school website, educational process, financial, inventory, transport, web services to make general data available to other cloud application.

MATERIALS AND METHODS

The research target is schools in the Sudan to unify the management systems of schools in one frame according to specific rules and policies which leads to increased efficiency and effectiveness and reduce the cost of old system style like hardware, network and maintenance. etc. To achieve that first we need to specify the cloud service model and then identify the school management information system object based on the selected cloud and finally the framework can be built based on these information.

Selecting Clouds

From cloud computing service model we selected the Cloud Software as a Service (SaaS) where provider's applications running on a cloud infrastructure can be used by the users. These applications have great level of accessibility throw a thin client application such as web browser. The underline cloud infrastructure such as network, servers, operating system, and storage are managed by provider. It might be possible for the subscriber to specify application configuration settings (Shirley Radack, 2012).

This cloud service model is type of external cloud infrastructures or package where the IT supports, services, and expertise are included in the package. The school needs to run only the provided applications and services. It will only need to have PCs, updated web browsers and internet connection. The application should be responsive to allow the user access the application from any device browsers.

The schools management information system

As the result of multi personal interview with schools managers we find that the standard school in the Sudan consists of manager, principal, teachers, and students. The standard school is selected from all the schools type primary and secondary, governmental and special. The primary schools consist of eight level and the secondary schools consist of three level. Administrative processes that should be computerized is the same in primary and secondary

schools so this research target both types of schools. According to this the school information system should contain these main **elements**:

- **School Buildings:** all basic information about school's buildings
- **Classes:** class information, level, capacity and supervisor.
- **Terms:** start and end of year and total student attend this year.
- **Students:** all student information, assign students to classes, fees, admission term and medical Information.
- **Teachers:** all teachers' information, qualifications, specialization and employment information.
- **Syllabus:** subject, level, term, duration and supervisor.
- **Activities:** all activity in school (sport, …)
- **Schedule:** to allocate syllabus and activities.
- **Calendar:** contains meetings, exam and test time.
- **Grades:** all students' marks, grades, results, teachers' comments, relayed students to next class.
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- **Employees:** all employee information, qualifications and salary information.
- **Financial:** account, payroll, employee's deductions-loans-balance, students' payment and invoices.
- **Inventory:** items, purchase
- **Transportation**: lines information's, vehicles information's, drivers.

Building the framework

After the selection of the cloud and identifying the main elements of schools information management system, the proposed framework can be built. Using any modern browser like Google Chrome, Firefox, Opera, Safari, and IE10, the users can access the school website which can also serve as the School Information System Portal (SISP). They can request data and computations from one or more services using Application Programming Interface (API). The different sub-systems for managing educational, financial, inventory, and transportation processes can be launched using the SISP. The website administrator can add, edit, delete, and deactivate links to the different information systems of the school. In the School Management Information System (SMIS), the following information systems have been defined and can be launched by the SISP: Education Information Management System (EIMS), Financial Information Management System (FIMS), Inventory Information Management System (IIMS), and Transportation Information Management System (TIMS). Authorized users can access the different school information system web pages and respective databases being hosted by different cloud service providers through the links in the main page based on their privileges. The system architecture of SMIS is designed as described in Fig.1.

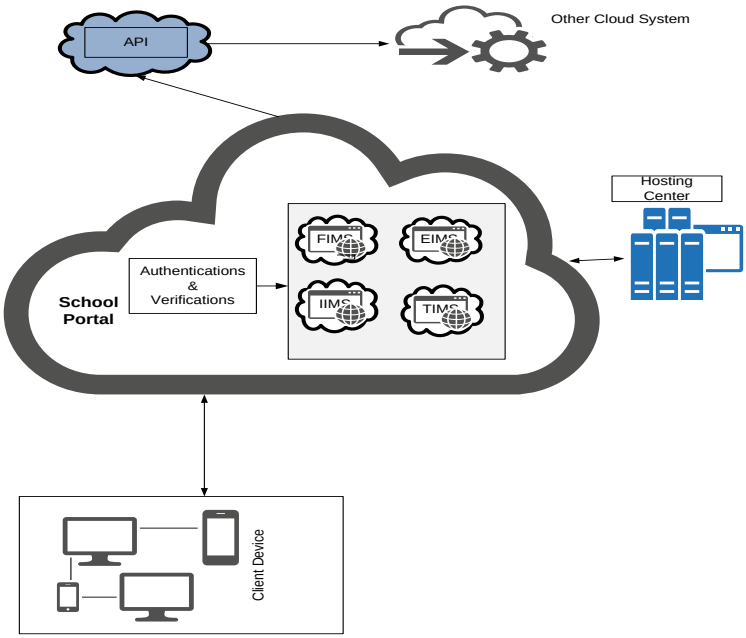


Fig.1. SMIS system architecture

The SMIS was designed such that anybody with internet access using modern browsers can visit the website of the school to view general information such as its mission, vision and objectives, school officials, contact details and history of the school, important announcements, recent and past events or activities of the school, and significant captured moments in the picture gallery. Authorized users and system administrators can edit and maintain all these information through a secured page. Archived contents may also be retrieved by authorized administrators. The main page provides links to different information systems of the school. These links or corresponding calls to the different software components are editable and maintainable by authorized administrators. Fig.2 shows the structure and features of the School Information System Portal (SISP).

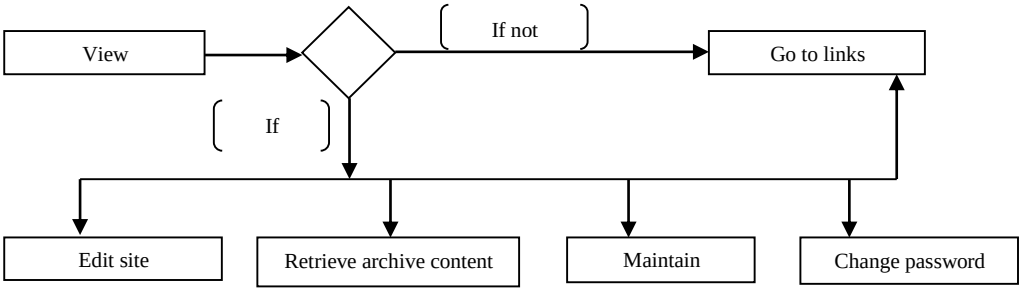


Fig.2. Structure and features of SISP

The application allow all members of school to register their account through email address and user name as shown in Fig.3

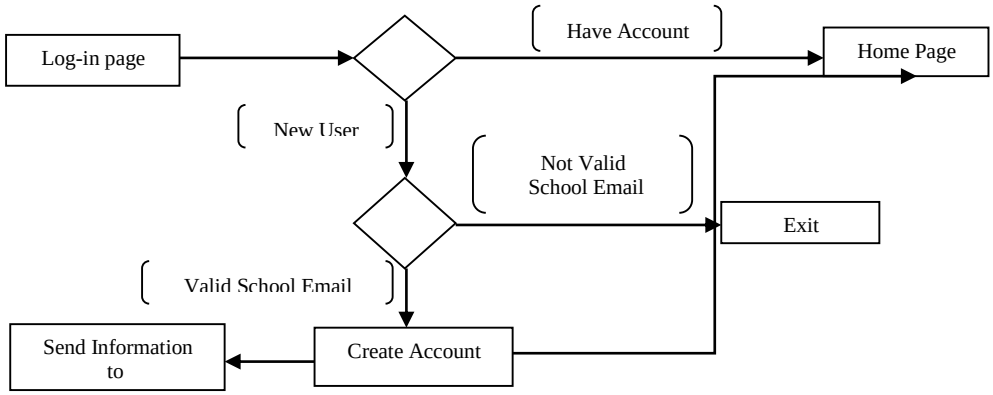


Fig.3. Structure and features of Registration Process

The required EIMS site can be launched using the link to the EIMS. Fig.4 shows the structure and features of the EIMS system.

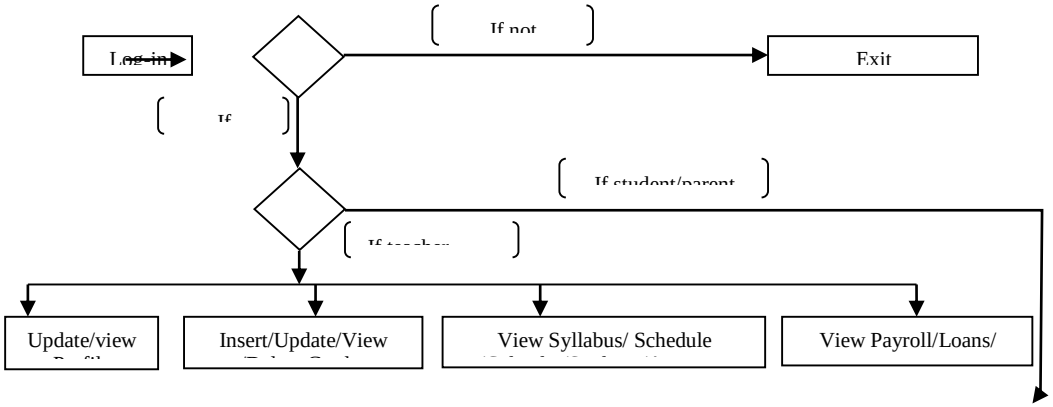


Fig.4. Structure and features of EIMS

The required FIMS site can be rendered using the link to the FIMS. Fig.5 shows the structure and features of the Financial Information Management System (FIMS).

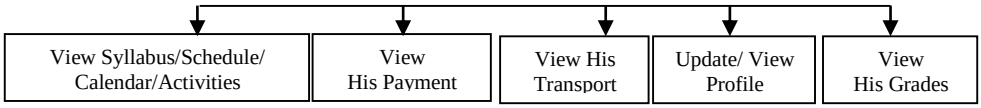


Fig.5. Structure and features of FIMS

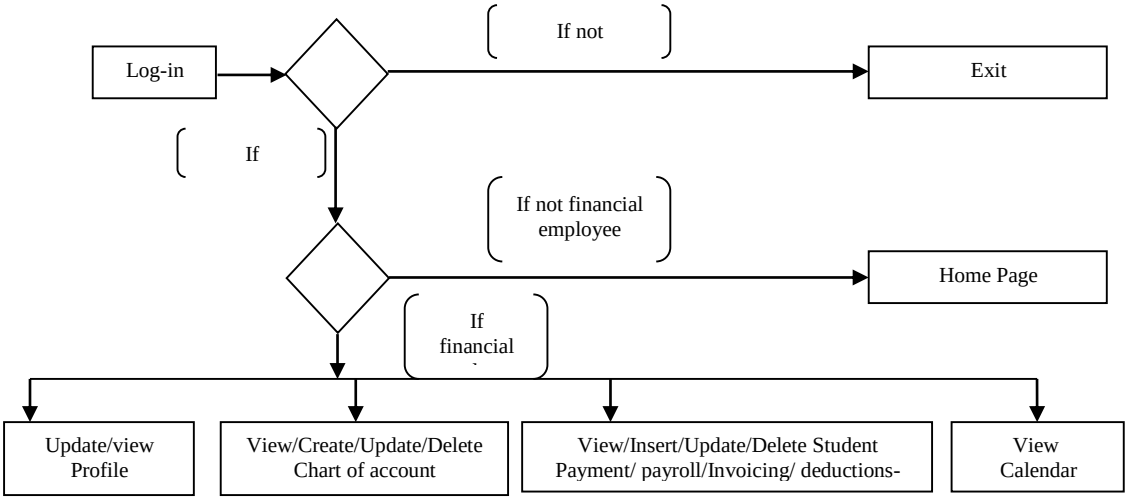


Fig.6. Structure and features of IIMS

The required IIMS can be launched using the IIMS site. Fig.6 shows the structure and features of the Inventory Information Management System (IIMS).

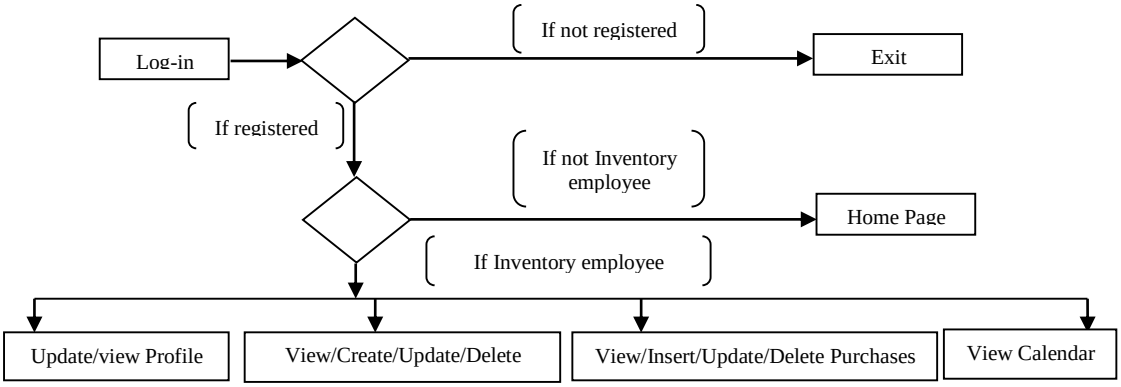


Fig.7. Structure and features of TIMS

The required TIMS can be launched using the TIM`S site. Fig.7 shows the structure and features of the Transport Information Management System (TIMS).

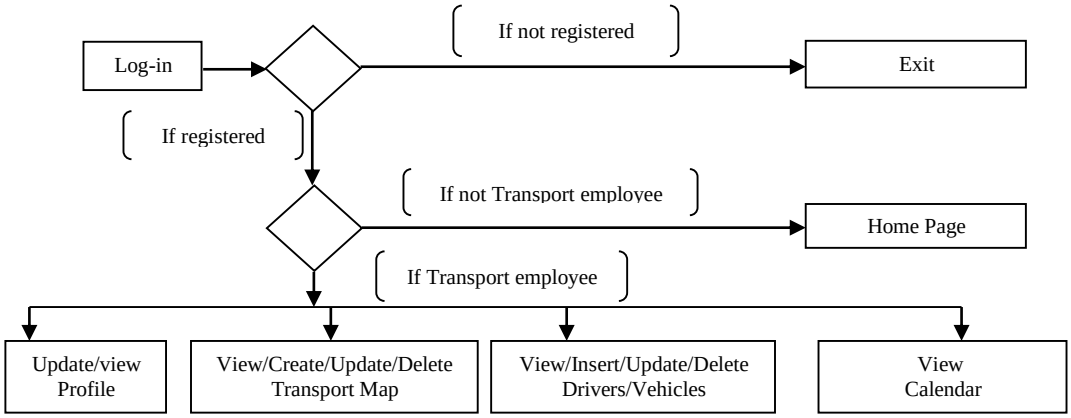


Fig.8. Structure and features of manger and system admin

Fig.8 shows the structure and the features of the schools managers and system administrators and how they can involve in all the tasks that are described by the previous figures.
The school applications access other cloud applications in other could using the API process which is depicted in fig9.

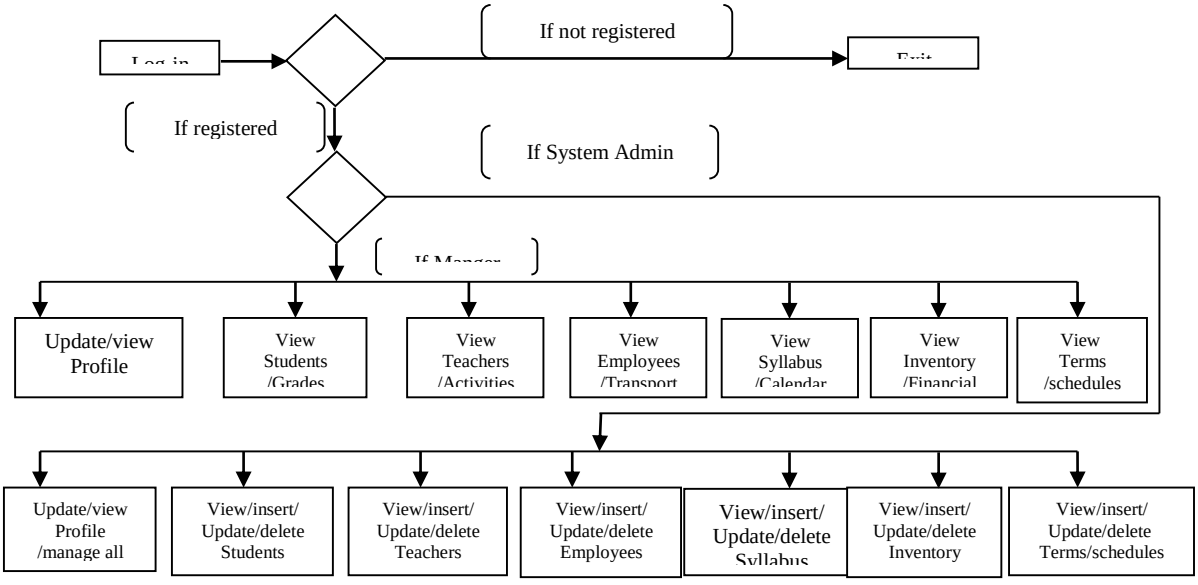


Fig.9. Structure and features of School API

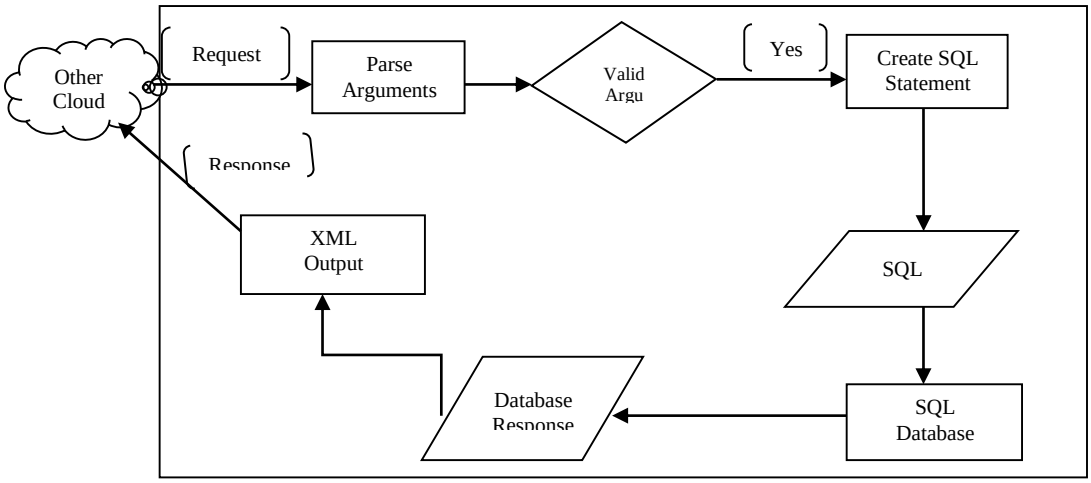
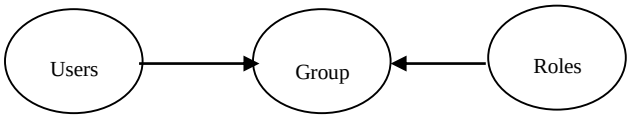


Fig.10. Structure of Security System

A hierarchical manner can be followed to secure the cloud application. In the hierarchical manner, every user can do a transaction after he is confirmed by his direct manager. Every user has user name and password and he belongs to specific groups. Every group has roles that allow the members of group to do specific tasks. Fig.10 shows the structure of security system.



Every transaction will be registered in a log file that contains all the transactions according to the date, time, and the user who committed the transaction. The log file also saves the error messages and location of the errors. The unified model Language (UML) is used to describe the structure of the overall application. PHP is used as web programming language together with MySQL front-end and DBMS to develop the application that is used to collect the evaluation measures.

RESULTS AND DISCUSSION

(a) Evaluating the framework

According to International Standard Organization (ISO) and the International Electro-technical Commission (IEC) there are quality characteristics and sub characteristics for measuring softwares. From these characteristics, the Functionality, Reliability and Maintainability characteristics were chosen to evaluate the proposed framework. As mentioned in the previous section, an application is built based on the presented framework. Then the measurements for the functionality, reliability, and maintainability metrics are taken for the developed application based on ISO/IEC 9126.

(b) Functionality metrics

Internal functionality metrics are used for predicting if the software product in question will satisfy prescribed functional requirements implied user needs. Fig11 shows how our designed application performed using the functionality metrics.

Table. 1 .The functionality metrics

Suitability metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Functional adequacy	How adequate are the checked functions?	X=1-A/B X=1-14/72; X=0.81 A= Number of functions in which problems are detected in evaluation B= Number of functions checked	0 ≤ X ≤ 1 The closer to 1, the more adequate.
Functional implementation completeness	How complete is the functional implementation?	X=1-A/B X=1-2/71; x=0.97 A=Number of missing functions detected in evaluation. B= Number of functions described in requirement specifications	0 ≤ X ≤ 1 The closer to 1, the more complete.
Functional implementation coverage	How correct is the functional implementation?	X=1-A/B X=1-16/71; X=0.77 A= Number of incorrectly implemented or missing functions detected. B= Number of functions described in requirement specifications	0 ≤ X ≤ 1 The closer to 1, the more correct.
Functional specification stability (volatility)	How stable is the functional specification during the development life cycle?	X=1-A/B X=1-4/71; X=0.94 A=Number of functions changed during development life cycle phases B=Number of functions described in requirement specifications	0 ≤ X ≤ 1 The closer to 1 the more stable.
Accuracy metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Computational Accuracy	How completely have the accuracy requirements been implemented?	X=A/B X=68/71; X=0.96 A= Number of functions in which specific accuracy requirements had been implemented, as confirmed in evaluation. B= Number of functions for which specific accuracy requirements need to be implemented.	0 ≤ X ≤ 1. The closer to 1, the more complete.
Precision	How complete was the implementation of specific levels of precision for the data items?	X=A/B X=28/29; X=0.97 A= Number of data items implemented with specific levels of precision, confirmed in evaluation B= Number of data items that require specific levels of precision	0 ≤ X ≤ 1. The closer to 1, the more complete.

Interoperability metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Data exchangeability (Data format based)	How correctly have the interface data formats been implemented?	X=A/B X=70/71; X=0.99 A=Number of interface data formats that have been implemented correctly as in the specifications B=Number of data formats to be exchanged as in the specifications	0 ≤ X ≤ 1. The closer to 1, the more correct.
Interface consistency (protocol)	How correctly have the interface protocols been implemented?	X=A/B X=69/71; X=0.97 A=Number of interface protocols implementing consistent format as in the specification confirmed in review B=Number of interface protocols to be implemented as in the specifications	0 ≤ X ≤ 1 The closer to 1, the more consistent.
Security metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Access auditability	How auditable is access login?	X=A/B X=4/4; X=1 A= Number of access types that are being logged as in the specifications B= Number of access types required to be logged in the specifications	0 ≤ X ≤ 1 The closer to 1, the more auditable.
Access controllability	How controllable is access to the system?	X=A/B X=7/7; X=1 A= Number of access controllability requirements implemented correctly as in the specifications. B= Number of access controllability requirements in the specifications.	0 ≤ X ≤ 1 The closer to 1, the more controllable.
Data corruption prevention	How complete is the implementation of data corruption prevention?	X=A/B X=23/25; X=0.92 A= Number of implemented instances of data corruption prevention as specified confirmed in review. B= Number of instances of operation/access identified in requirements as capable of corrupting/destroying data Note: Consider security levels when using this metric.	0 ≤ X ≤ 1 The closer to 1, the more complete.
Data encryption	How complete is the implementation of data encryption?	X=A/B X=0/10; X=0 A=Number of implemented instances of encryptable/decryptable data items as specified confirmed in review B= Number of data items requiring data encryption/decryption facility as in specifications *NOTE: Data encryption: e.g., data in open database, data in public communication facility*	0 ≤ X ≤ 1 The closer to 1, the more complete.
functionality compliance metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Functional compliance	How compliant is the functionality of the product to applicable regulations, standards and conventions?	X=A/B X=8/8; X=1 A= Number of correctly implemented items related to functionality compliance confirmed in evaluation B= Total number of compliance items	0 ≤ X ≤ 1. The closer to 1, the more compliant.

Intersystem standard compliance	How compliant are the interfaces to applicable regulations, standards and conventions?	X=A/B X=5/5; X=1 A= Number of correctly implemented interfaces as specified, confirmed in review B= Total number of interfaces requiring compliance	0 ≤ X ≤ 1. The closer to 1, the more compliant.

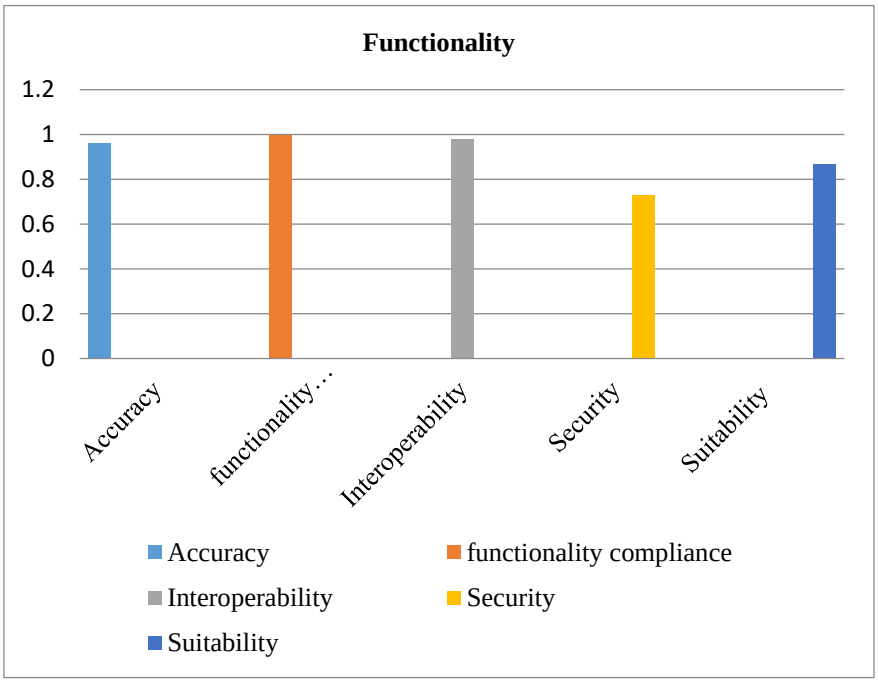


Fig.11.The performance of the designed application using the functionality metrics

(c) Reliability Metrics

Internal reliability metrics are used for predicting if the software product in question will satisfy prescribed reliability needs, during the development of the software product. Fig12 shows how our designed application performed using the reliability metrics.

Table. 2 .The reliability metrics

Maturity metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Fault detection ***Note:*** *this metric should only be used for prediction during development.*	How many faults were detected in reviewed product?	X=A/B X=45/250; X=0.18 A=Absolute number of faults detected in review B=Number of estimated faults to be detected in review (using past history or reference model)	$0 \leq X \leq 1$. The closer to 1, the more compliant.
Fault removal	How many faults have been corrected? What is the proportion of faults removed?	X=A X=43 A=Number of corrected faults in design/coding Y=A/B Y=43/45; Y=0.96 A=Number of corrected faults design/coding B= Number of faults detected in review	$0 \leq X$ A high value of X implies, that less faults remain. $0 \leq Y \leq 1$ The closer to 1, the better. (more faults removed)
Test adequacy	How much of the required test cases are covered by the test plan?	X=A/B X=70/72; X=0.97 A=Number of test cases designed in test plan and confirmed in review B= Number of test cases required	$0 \leq X$ Where X is greater the better adequacy

Recoverability metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Restorability	How capable is the product in restoring itself after abnormal event or at request?	X=A/B X=2/2; X=1 A=Number of implemented restoration requirements confirmed in review B=Number of restoration requirements in the specifications	$0 \leq X \leq 1$ Where X is greater, the better restorability

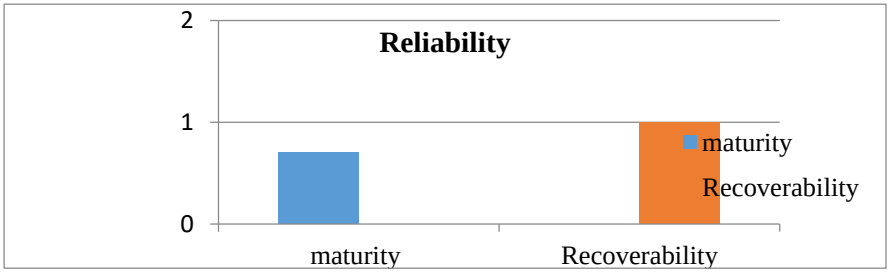


Fig.12. the performance of the designed application using the reliability metrics

(d) Maintainability metrics

Internal maintainability metrics are used for predicting the level of effort required for modifying the software product table 3 describe these metrics. Fig13 shows how our designed application performed using the maintainability metrics.

Table 3. The maintainability metrics

Analyzability metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Activity recording	How thorough is the recording of the system status?	X=A/B X=7/7; X=1 A=Number of implemented data login items as specified confirmed in review B=Number of data items to be logged defined in the specifications	$0 \leq X \leq 1$ The closer to 1, more data provided to record system status.
Readiness of diagnostic function	How thorough is the provision of the diagnostic functions?	X=A/B X=1/1; X=1 A=Number of implemented diagnostic functions as specified confirmed in review B=Number of diagnostic functions required	$0 \leq X$ The closer to 1, the better implementation of diagnostic functions.
Changeability metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Change recordability	Are changes to specifications and program modules recorded adequately in the code with comment lines?	X=A/B X=2/17; X=0.12 A=Number of changes in functions/modules having change comments confirmed in review B=Total number of functions/modules changed from original code	$0 \leq X \leq 1$ The closer to 1, the more recordable. The change control 0 indicates poor change control or little changes, high stability.
Stability metrics			
Metrics	**Purpose**	**Formula**	**Interpretation**
Change impact	What is the frequency of adverse impacts after modification?	X=1-A/B X=1-1/4; X=0. 75 A=Number of detected adverse impacts after modifications B=Number of modifications made	$0 \leq X \leq 1$ The closer to 1, the better.

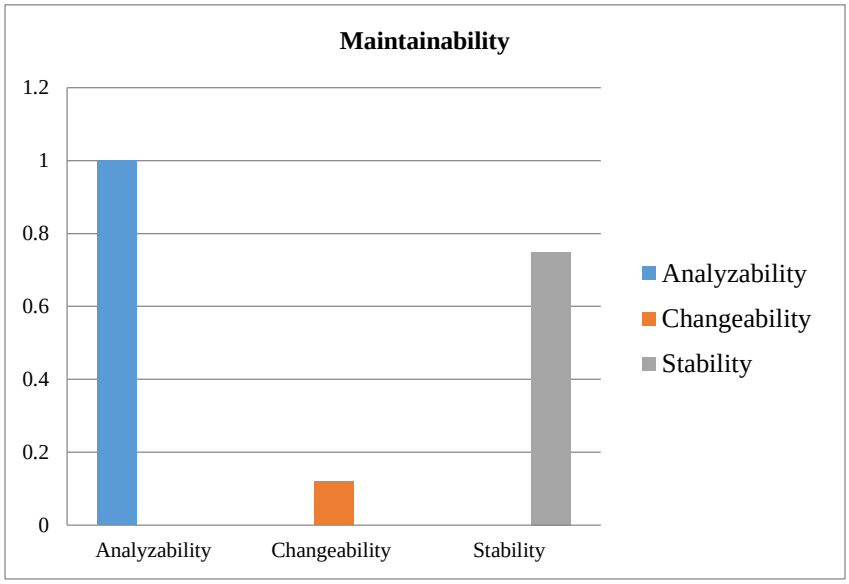


Fig.13.The performance of the designed application using the maintainability metrics

Table .4 .Summary of the performance of the designed application

Summary		
Characteristics	**Result**	**Interpretation**
Functionality	0.88	$0 \leq X \leq 1$ The closer to 1, the better is.
Reliability	0.78	$0 \leq X \leq 1$ The closer to 1, the better is.
Maintainability	0.62	$0 \leq X \leq 1$ The closer to 1, the better is.

Table 4 summarize the performance of the designed application in the selected evolution metrics. Adopting the proposed frame work will help schools in the Sudan in many aspects. With this proposed approach we find that cloud based application is very helpful for schools in the Sudan. It can reduce the cost of traditional system and also reduce the cost of hardware, network, software and maintenance. Also it can unify the management systems in all the schools through the use of the API, so every school can interact with other schools. The API can enable the government to monitor the performances of the schools and make data and information available for the decision makers.

CONCLUSION

Cloud based computing in education management is a relatively new field that not only needs an in-depth studies on its application and utilization in schools but also on their effectiveness and efficiency in education management. Most of the managerial work in today's world depends on the traditional system rather than utilizing the information technology.

In this research the application of cloud computing in the education environment is studied. The research also shows how the application of cloud computing can improve the efficiency of education management. This study also shows the importance of providing management information system for schools based on the cloud computing so that schools administrators and government can have more information and thus take a timely decisions and strategic plans. To prove this finding, a framework is designed after analyzing the functions of schools and defining the main elements that exists in every school and showing the relation between these elements. The designed framework is evaluated by building a web-based application and then the functionality, reliability, and maintainability metrics are measured. The result of the evaluation is satisfactory.

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منهجية لنظم ادارة المدارس على الحوسبة السحابية

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جامعة الجزيرة

الملخص

تلعب انظمة المعلومات الإدارية دوراً أساسياً لنجاح إدارة المدارس. وقد كان الغرض الرئيسي من نظام المعلومات الإدارية في مراحل تطوره الأولى هو تحسين كفاءة أنشطة المكتب. في البيئة المدرسية تستخدم نظام المعلومات الإدارية لتخزين بيانات الطلاب والموظفين ، مع التركيز على إدخال البيانات ومقارنتها بدلاً من التركيز على نقل البيانات أو تحليلها. هذه الورقة تقدم مقترح إطار عمل على أساس الحوسبة السحابية لتوفر معلومات تفصيلية وموجزة عن المجالات الحساسة من أنشطة إدارة لتمكين مديري المدارس في التخطيط واتخاذ القرار. بحيث يمكن نظام المعلومات من الوصول إليها في أي مكان وأي زمان كما يتم تخزين البيانات في المخدمات البعيدة والتي هي في متناول المستخدمين عبر شبكة الانترنت. تم استخدام لغة النمذجة الموحدة (UML) في تطوير مقترح هذا الإطار. ولتقييمه تم تطوير تطبيق على شبكة الإنترنت باستخدام الإطار المقترح، كما تم استخدام بعض معايير منظمة المقاييس الدولية (ISO) لتقييم التطبيق على شبكة الإنترنت باستخدام بعض الخصائص المحددة. وقد أظهرت نتائج التقييم أن الإطار المقترح فعال جداً. ومن خلال التقييم، وجدنا ان الإطار المقترح يمثل حل لمعظم المشاكل المذكورة في الأبحاث السابقة، وهذا يعني أنه يمكن اعتماده من قبل المدارس ليوفر بذلك كفاءة أكثر لإدارة المعلومات ، ويجعل القرارات الإدارية أكثر فعالية.