Development of Software System for Hardware Maintenance Apprenticeship in Uyo Metropolis

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Abstract
The study was Development of Software System for Hardware Maintenance Apprenticeship in Uyo Metropolis. The purpose of the study was to design and determine the perception of hardware maintenance technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Motherboard, keyboard, monitor, Power Pack, and Hard disk. The descriptive survey design was used for the study, waterfall software design model was adopted for the development process. Visual Basic code was use as programming language, MS Access for database and window operating system. In order to achieve the objectives, five research questions with corresponding null hypotheses were raised to provide direction for the study. The researcher developed instrument tagged: hardware software system for hardware maintenance Questionnaire that was used for data collection. The population of the study consisted 280 Technicians drawn from computer maintenance shops in Uyo metropolis. A sample size of 162 respondents consisting of technicians and apprentice were selected using a simple random technique. Means and standard Deviation were used to answer the research question while T-test Analysis was used to test the Null Hypotheses at 0.5 level of significance using Statistical Package for Social Science (SPSS).The findings of the study showed that The perceptions of maintenance technician on the efficiency on the developed software system for hardware maintenance apprenticeship on motherboard, keyboard, monitor, power pack and hard disk were very high. It was recommended that the developed software system should be integrated into school curriculum for Universities and Training Centers. Workshops should be organized by skill acquisition agencies for the use of the software system to enhance skill development.

Keywords: software development, maintenance, hardware, apprenticeship

Introduction

The task of troubleshooting may be described simply. Given that a system is not functioning properly, the troubleshooter must attempt to locate the reason for the malfunction and must then repair or replace the faulty component. The level with which the source of the problem is identified depends on the troubleshooter's role and the current demand of the situation. For example, the troubleshooter may elect to replace a component or module, or perform some compensatory action to enable the system to continue functioning temporarily.

DRM Associates (2017) Introduced a computer troubleshooting system pending on the problems based on intelligent system. The system was developed to detect any hardware fault in computer system. Intelligent Systems (IS) as an applied field of Artificial Intelligence (AI) encompasses the principles, methodologies, techniques, processes and applications in real world problem solving contexts (Russell and Norvig,2018). Currently, intelligent system (IS) is a field that studies intelligent behaviors and their implementations as well as their impacts on human society (Sun and Firmin,2013). An intelligent system (IS) is a system that can imitate, and or automate intelligent behaviors of human beings, and solve problems that were previously solved by humans through generating representations, and adopting inference procedures and learning strategies (Schalkoff,el al.,2014). An Intelligence System (IS) embodies a form of computing that is based on an inexact, fuzzy and ambiguous model (similar to human reasoning) The difference between IS and non-intelligent systems is that the former emphasize the representation, emulation and simulation of intelligent behaviors towards their implementation using computing devices or software systems; the latter stress to realize one or a series of human actions or behaviors.

In a computer troubleshooting, the term troubleshooting is made use of when the system appears to have some problems that are related to its hardware while if the problem has something to do with the software then it is termed debugging. Troubleshooting generally refers to the process of arriving at the bottom of the problem and setting it right by looking into the probable cause of the trouble and repairing. There are many simple computer troubleshooting techniques that can be employed when the system is not working as it should. Some of the main points that could possibly be looked into are: Ensuring that all the parts are intact. If there are doubts try replacing what is not right to see if the system works well again. See that all cables that go to and from the system are plugged in securely particularly the power cable that supplies power to the system. These problems need Information and Communication Technology (ICT) technicians to be solved. However, it is observed that the ICT technicians follow (manual) ways of solving resolving computer problems hence taking cumbersome procedurals to arrive at the solutions.

An intelligent system is one component of an artificial intelligence which is working like human expert but it cannot replace human expert. It supports human experts in making decision that is it acts in all respect of human counterpart. Sometimes interchangeably used as knowledge-based system and is computer software which makes decision like a human expert. According to (Sun and Firmin, 2013) stated that the benefit of intelligent system above traditional programming language is that it does not depend on the code instead the data is stored in different location called knowledge base. Due to this reason, intelligent systems are not required to be programmed as the domain knowledge changes from time to time or from expert to expert knowledge. In real situation intelligent systems are applied in different decision making process from medical activities to intelligent decision making purpose. The concept of intelligent system has emerged in information technology as a type of system derived from successful applications of artificial intelligence. The goal of this research is to give a general description of an intelligent system, which integrates previous approaches and takes into account recent advances in artificial intelligence. The research describes an intelligent system in a generic way, identifying its main properties and functional components, and presents some common categories. The presented description follows a practical approach to be used by system engineers. Its generality and its use is illustrated with real-world system examples, Self-Learning Computer Troubleshooting, Expert System appropriate troubleshooting for maintenance, fault indication and accessing the knowledge base. The computer troubleshooting expert system according to (Sun and Firmin,2013) presents the technician with a list of guiding questions, when answered; provide the system with information about what problem sets the issue may belong to, and which ones it does not belong to. It then generates another list of questions that apply to subsets of those identified questions. After finding specific causes the system provides possible troubleshooting mechanism for the technician. This process can save time, energy and cost through by saving the current list of questions and possible solutions. There are a number of different approaches for designing knowledge based system but this self-learning computer troubleshooting expert system focused on rule based approach.

This expert system has also self-learning ability to handle new problems occurring in the computer system and their respective solutions. Each computer parts have its own troubleshooting mechanisms to assure its integrity in the time of problem occurrence in the computer system. Therefore, fetching out one or more problems occurred in the computer component is challenging task for the ICT technician. The ICT professional is educated to use the limited number of troubleshooting resources to maintain computer components problem specifically, due to this solving the problem is not simple task for the technician. To solve the problem of limited number of troubleshooting resources and to support ICT technician skill expert system support is crucial. Using the intelligent system, the required time and cost for identification of fault and repairing the fault is decreased. Mandal, (2013) stated that the demand for higher availability of production systems to have a cost-effective distribution of fixed assets and to minimize manufacturing delays due to machine failures caused by unplanned downtimes. Unplanned downtime increases the maintenance costs and reduces productivity, Information system has turned out to be more persuasive in the society today and with the myriad advances in information technology, automated computer fault diagnosis system has become so fundamental that every organization has to embark upon. Computer systems (hardware and software connection) face problems from time to time and endanger the functionality of the organizations. These problems need Information and Communication Technology (ICT) technicians to solve. There are a number of different approaches for designing knowledge based system but this self–learning computer troubleshooting expert system will focus on rule based approach. Computer components are classified basically into two: such as hardware and software. The hardware itself is classified into different specific components and software is also classified into application software and system software. These components may face problems due to different reasons. The components that require maintenance are; the motherboard maintenance, keyboard maintenance, monitor maintenance, power pack and Hard Disk maintenance. Computer maintenance according to Poland, (2017) is the process of ensuring routine servicing of computer components and also detecting fault for repairs when need arises. It is also a process of preserving or situation or effort taken to keep the condition and performance of a machine. It therefore implies that for effective functioning of any computer system it is necessary to be carrying out routine maintenance, for the purpose of this study, the following variables are taking into consideration for the development of the software system which are; Motherboard, Keyboard, Monitor, Power pack and Hard disk.

Motherboard problem are generally similar to CPU problems, Benson, (2014) indicated that faults associated with mother board are inability to display information or data, system reboot, over heating that can cause poor graphic display, noise peeps during booting, increased windows error or ‘’blue screens is death’’, freeze or glitches the computer, hardware is not recognized, slow down performance, not enough power and data speed to the component, burning smell from mother board and motherboard bend. Motherboard problems and power problems are probably the most difficult issues to troubleshoot. Various components are located on the motherboard, many things can cause errors. POST (power-on self- test) is one of the most beneficial aids for troubleshooting a motherboard. The meaning of any codes that appear on the screen should be researched. If multiple POST error codes appear, it should be troubleshooted in order of occurrences through expect system.

Keyboard is an input device that enables data to be keyed into the computer system. Benny (2014) opinioned that input is whatever goes into the computer and Input can take a variety of forms, from commands instruction or data are entered from one computer to another (via a network connection) or device. A device that feed data into a computer such as a keyboard or mouse, is called an input device. As computers are sold all over the world, there are many different keyboard configurations, which include different accented letters and currency symbols. Computer operating systems can be configured to use various different regional keyboards. Common reasons exist as to why PC keyboard may not correspond with what appears on the screen. This may be keyboard incorrectly configured or have inadvertently switched on a “number lock’’ feature on the keyboard or it may be incorrectly set to the wrong keyboard layout thereby posing serious challenges in resolving keyboard problem.

Monitor of a computer goes blank is an indication of fault that need to be traced and maintain. It could be there is a problem with power settings or a more complex problem with the computer hardware. (Ashhley and Ojo 2013) describes output as any information processed by and sent out from a computer or other electronic device. An example of output is anything viewed on your computer monitor screen, such as the words you type on your keyboard. Without some type of output that a human could see, feel, or hear, human could not interact with the computer. There are four basic types of output; audio output, graphic output, text output and video output. (Staples and Searle 2014) indicate issues that associate with monitor are inability for the monitor to turn on, monitor already turned on but there is no picture, video light is too dark or bright, images on the screen do not match the screen size, flickering monitor, monitor and video card problem, crack or visible spot on the screen, it should be troubleshooted in order of occurance after testing components.

Power pack is the component of the system that ensures effective or adequate supply of electricity to the entire system for stability and general functionality. As mentioned earlier, power pack problem is one of the most difficult issues to troubleshoot. Tella, (2014) stated that the most likely problem associated with power pack is the sleeping of the computer mode, wrong power setting will first kill the display, Age, electric interference, Dirt or foreign substance, brown-outs, overheating and or ventilation failures.

Hard disk, also called hard disk drive or hard drive magnetic storage medium for a computer. Hard disks are flat circular plates made of aluminous or glass and coated with a magnetic material. Hard disks for personal computers can store terabytes 9trillions of bytes of information. Benson, (2014), the most likely problems associated with hard disk is human error, hard-ware failure, firm ware corruption, water Damage, power issues, and unforeseen mishaps. Problems of this magnitude are always difficult to trace manually. In most cases as opinion by

(Sullivan and Mike, 2013) tracing fault and error in computer system requires special software in order to meet system down – time for organizational operations. This implies that, there is need for expert troubleshooting software to enhance such activities. Troubleshooting is a process of analyzing fault symptoms in order to determine the type of fault that the system is having for possible solutions. Base on the difficulties of fault tracing, there is need to develop software that will enhance fault dictation by technicians and other computer maintenance centers. It is believe that the understanding of the functioning of these components is vital for the development of an efficiency software system, hence, the need to incorporate into the apprenticeship.

Apprenticeship is a system for training a new generation of practitioners of a trade or profession with on-the-job training and often some accompanying study (classroom work and reading). Apprenticeships can also enable practitioners to gain a license to practice in a regulated occupation. Most of their training is done while working for an employer who helps the apprentice learn their trade or profession, in exchange for their continued labor for an agreed period after they have achieved measurable competencies. This work will be of immense benefits to them in such that it will proffers better performance in resolving common challenges confronted in existing computer systems. It is believed that it will provide the meet and exceeds users' requirements for a modern computer system.

Statement of the Problem

The computer has witnessed a wide range of application in virtually all human endeavours. It has also found its way into the classroom and educators now look in its way as a panacea to prevalent pedagogical challenges. Researchers have indicated that appropriate use of the computer for science instruction facilitates teaching, learning and apprenticeship program for skill acquisition. It is generally observed that many organizations have resulted to procuring new computer system in their budget every year because of lack of proper maintenance system or culture. Some of this poor maintenance culture came into force because it is always difficult to detect electronic fault. Most of the computer faults are associated with motherboard, keyboard, power pack, Hard disk (memory).

Nelson, (2015) stated that abandoning of systems by organization due to lack of technical experts to identify and maintain such fault. A lot of fault tracing are documented through maintenance manual and most of the technicians to the best of my knowledge are not knowledgeable enough to read and understand the processes of tracing computer system fault, rather rely on experience that does not match with the existing technology. The task of accurately diagnosing a system failure can be prone to error thereby leaving system with probable additional damage from erroneous diagnosis. It is therefore imperative that computer troubleshooting should be an undertaking which has standard steps and tested guidelines in its approach to diagnosing and solving system problems. Even with industry best-practice solutions are available to solve the nature of problems having varying methods of solution. Currently to the best of my knowledge, there is no available expert system developed that can meet the demands of such system new technologies. It is therefore imperative to develop new approaches, algorithms and or models for expert systems to cope with the fearing need of solving and troubleshooting hardware maintenance problems. It is against this background that the researcher researches on the existing technological evolutions and its relevant problem to develop an intelligent software system for hardware maintenance.

Purpose of the Study

The purpose of the study is to developed software system for hardware maintenance apprenticeship in Uyo Metopolis.

Specifically, the study sought to;

i. Develop Software System for hardware Maintenance apprenticeship programme.
ii. To determine the mean perception of technicians on the efficiency of the developed software system for hardware maintenance apprenticeship on Motherboard.
iii. To determine the mean perception of technicians on the efficiency of the developed software system for hardware maintenance apprenticeship on Keyboard.
iv. To determine the mean perception of technicians on the efficiency of the developed software system for hardware maintenance apprenticeship on Monitor.
v. To determine the mean perception of technicians on the efficiency of the developed software system for hardware maintenance apprenticeship on Power pack
vi. To determine the mean perception of technicians on the efficiency of the developed software system for hardware maintenance apprenticeship on Hard disk.

Research Questions

The following research questions are raised to guide the study.

i. What is the mean perception of technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Motherboard.
ii. What is the mean perception of technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Keyboard?
iii. What is the mean perception of technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Monitor?
iv. What is the mean perception of technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Power pack?
v. What is the mean perception of technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Hard disk?

Null Hypotheses

The following research hypotheses are generated by the researcher and will be tested during the study;

i. Ho_1: There is no significant difference in the mean response of technicians and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Motherboard.

ii. Ho_2: There is no significant difference in the mean response of technicians and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Keyboard.

iii. Ho_3: There is no significant difference in the mean response of technicians and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Monitor.

iv. Ho_4: There is no significant difference in the mean response of technicians and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Power pack.

v. Ho_5: There is no significant difference in the mean response of technicians and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Hard disk.

Research Methodology

Design of the Study

The design of the study is in two perspectives, the software design and descriptive survey design.

Software design

The study adopted waterfall model as shown in the figure below:

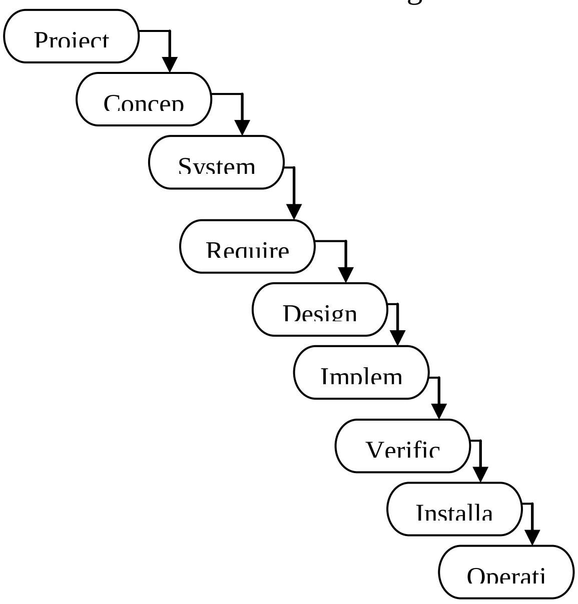

Figure 1: The waterfall model of software development is an activity-centered view of the software life cycle: Software development activities are performed in sequence (project management and cross-development processes are omitted).

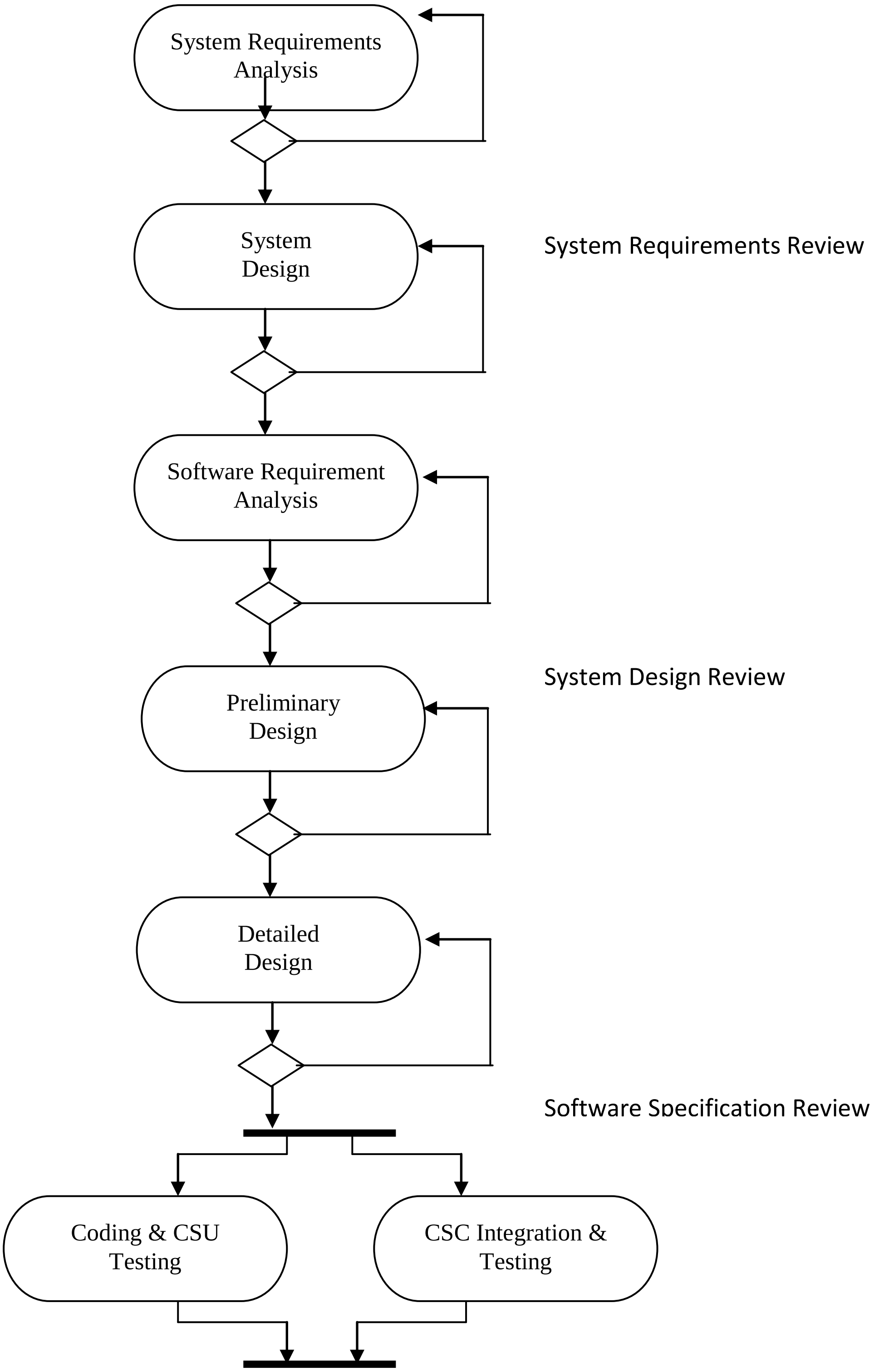

Figure 2: Waterfall model widely used.

Decision points denote review: The subsequent activity is initiated only if the review is successful. The requirements activities are all completed before the system design activity starts. The goal is to never turn back once an activity is completed. The key feature of his model is the constant verification activity (called "verification step") that ensures that each development activity does not introduce unwanted or deletes mandatory requirements. This model provides a simple (or even simplistic) view of software development that measures progress by the number of tasks that have been completed.

The model assumes that software development can be scheduled as a step-by-step process that transforms user needs into code. Figure 11-12 shows a widely used waterfall model. The main characteristic of this model is that each development activity is followed by a review. The starting point in this model is the system requirements analysis activity whose goal is to generate unambiguous system requirements. The first review is the System Requirements Review, during which the requirements are reviewed with respect to completeness, consistency, and clarity.

The system requirements are the basis for the system design activity, which generates the system design. The system design is reviewed during the System Design Review activity. The system design is baselined once the system design review is successfully completed. The functional baseline serves as the starting point for the software requirements analysis, which creates the software requirements. The software requirements are then reviewed and base lined before serving as a basis for implementation. Implementation starts with the preliminary design followed by the detailed design activity. An important review is the critical design activity review (CDR). Coding does not occur before the CDR completes successfully.

Area of the Study

The area of the study is Uyo in Akwa Ibom State Nigeria. Uyo is one of the three (3) senatorial district in Akwa Ibom State. The senatorial district has 3 federal constituencies namely; Etinan, uyo and Itu/Ibiono federal constituencies. Uyo is located at latitude $4^{0}49^{1}$ and $3^{0}22$ N and longitude $7^{0}48^{1}$ and $8^{0}14^{1}$, and it covers approximately 45,109km^{2} with a population of about 674,500 (Ministry of economic development Uyo, 2019).

Uyo houses the state capital of the state. It houses also University of Uyo, A large percentage of people in this area are subsistence farmers. Others engages in trading and white collar jobs while many people engages in teaching both in private and public secondary schools. The rational for using Uyo is that quarter of business centers of various dimensions which include sales and maintenance of computer system and other computer accessories are there.

Population of the Study

The population of the study consisted of 280 computer maintenance workers in Uyo metropolis from 20 recognize shops in Uyo metropolis. (Appendix II) pg 93

Sample and Sampling Technique

The sample of the study was made up of 162 respondents were randomly selected consisting of technicians and apprentices. The sample size was determined using Krejice and Morgan, (2005) Sampling model. The sampling Technique used was simple random selection of respondents from respective computer maintenance shops.

Instrumentation

The researcher developed instrument tittled ''Hardware Software System for Maintenance Apprenticeship'' (HSMA) Questionnaire that was used in collecting data for the study. The instant was meant for computer maintenance technicians that train apprentice. The questionnaire was divided into two sections (A and B). Section "A" contained the personal data of the respondents. Section ''B'' contained the items on the variables. The items were structured on motherboard, keyboard, power pack, monitor, Hard disk. Responses on each variable were made on a 5 point rating scale such as; very High efficient (VHE) = 5 point, High efficient (HE) = 4 points, moderate efficient (ME) = 3 point, Low efficient (LE) = 2 point very low efficient (VLE) = 1 point.

Validation of the Instrument

The researcher instrument was given for face validation to three expert. One from department of computer science, one from TENO Electronic service and one from measurement and Evaluation unit in University of Uyo. The validate read through the instrument item by item, made corrections where necessary and indicate the suitability of the items for answering the research questions, their comments were utilized in making adjustment and modification for final copy of the instruments that was used for data collection.

Reliability of the Instrument

The trial test of the instrument was done. The instrument, ISCMA was administered to 20 computer maintenance technicians in Ikot Ekpene and Abak L.G.A who have similar characteristics who were not part of the population or sample. In order to ascertain reliability of the instrument, According to Udo (2014), The data obtained was analyzed after collection using Chronbach's alpha statistical tool to determine reliability. The reliability coefficient obtained was 0.81. The high reliability index made the instrument suitable for the study.

Method of Data Collection

The questionnaire was administered on the respondents by the researcher and two research assistants. The research assistants were briefed by the researcher on the procedure for administration and collection of the instrument from the respondents after two month of utilization of the software system. The administration of the instrument was done within two weeks. Copies of the questionnaire were collected from the respondents immediately after completion within three days to avoid misplacement. A total of 162 copies of the questionnaire were distributed. All were successfully returned by the respondent, hence 100 percent rate of return.

Method of Data Analysis

Means and Standard Deviation were used to answer the research question while t-test analysis was used to test the hypotheses at 0.5 level of significance using statistical package for social science (SPSS).

Decision Rule

The decision in regarded to research question was determined using upper and lower limit as indicated below;

Response option	Value	Real limit
Very High Efficient (VHE)	5	4.50 – 5.00
High Efficient (HE)	4	3.50 – 4.49
Moderate Efficient (ME)	3	2.50 – 3.49
Low Efficient (LE)	2	1.50 – 2.49

Very Low Efficient (VLE)	1	0.50 – 1.49

RESULTS

Research Question 1

What is the mean perception of computer maintenance technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Motherboard?

Table 1 Mean perceptions of computer maintenance technician in the efficiency of the developed software system for computer maintenance apprenticeship on motherboard

	Items	n	$\bar{x}$	Std. Deviation	Remark
1.	Ability to use the developed computer maintenance software system for handling motherboard	162	4.42	0.21	High Extent
2.	Ability to detect low energy supply	162	4.78	0.45	Very High Extent
3.	Ability to detect faulty DOS process	162	4.53	0.67	Very High Extent
4.	Ability to show and installed IC in the motherboard	162	4.65	0.57	Very High Extent
5.	Ability to identify processor chips in the motherboard	162	4.03	0.24	High Extent
6.	Ability to detect all possible Connections on the motherboard	162	4.52	0.67	Very High Extent
7.	Ability to detect that the motherboard is coordinating other components	162	4.38	0.64	High Extent

Source: Field Data (2023)

The data presented in Table 1 shows that the mean Perceptions of computer maintenance technician on the efficiency of the developed software system for computer maintenance apprenticeship on motherboard indicated very high extent. This is because the results of the responses on each item was greater than 2.50, which was the criterion for the decision rule.

Research Question 2

What is the mean perception of computer maintenance technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Keyboard?

Table 2: Mean perceptions of computer maintenance Technician in the efficiency of the developed software system for computer hardware maintenance apprenticeship on keyboard

	items	n	$\bar{x}$	Std. Deviation	Remark
1.	Ability to detect no communication between the keyboard and the motherboard	162	4.67	0.60	Very High Extent
2.	Ability to detect no signal between the keys and keyboard plates	162	4.59	0.85	Very High Extent
3.	Ability to detect functionality	162	4.63	0.55	Very High Extent

4.	Ability to detect when there is no keyboard Extent connection	162	4.55	0.57	Very High
5.	Ability to identify keyboard language configuration	162	4.29	0.89	High Extent
6.	Ability to troubleshoot keyboard if not respondent	162	4.30	0.87	High Extent
7.	Ability to detect keyboard connection	162	4.42	0.79	High Extent

Source: Field Data (2023)

The data presented in Table 2 shows that the mean perceptions of computer maintenance technician in the efficiency of the developed software system for computer maintenance apprenticeship on keyboard indicated Very high extent. This is because the result of the responses on each item was greater than 2.50, which was the criterion for the decision rule.

Research Question 3

What is the mean perception of computer maintenance technician on the efficiency of the developed hardware software for hardware maintenance apprenticeship on Monitor?

Table 3: Mean perceptions of computer maintenance technician in the efficiency of the developed software system for computer hardware maintenance apprenticeship on monitor

items	n	$\overline{x}$	Std. Deviation	Remarks
1. Ability to detect low voltage in the monitor	162	4.50	0.79	Very High Extent
2. Ability to detect communication between monitor and motherboard	162	4.63	0.58	Very High Extent
3. Ability to detect sharing display fault	162	4.65	0.57	Very High Extent
4. Ability to detect CRT failure	162	4.43	0.83	High Extent
5. Ability to detect monitor's sound failure	162	4.37	0.66	High Extent
6. Ability to detect VGA card failure	162	4.52	0.65	Very High Extent
7. Ability to isolate bad capacitor and other components from the monitor	162	4.28	0.78	High Extent

Source: Field Data (2023)

The data presented in Table 3 shows that the mean perceptions of computer maintenance technician in the efficiency of the developed software system for computer maintenance, apprenticeship on monitor indicated very high extent. This is because the results of the responses on each item was greater than 2.50, which was the criterion for the decision rule.

Research Question 4

What is the mean perception of computer maintenance technician on the efficiency of the developed software system for hardware maintenance apprenticeship on Power pack?

Table 4: Mean perceptions of computer maintenance technician on the efficiency of the developed software system for computer hardware maintenance apprenticeship on Power pack

items	n	$\bar{x}$	Std. Deviation	Remark
1. Ability to detect low voltage in the Power pack problem	162	4.55	0.69	Very High Extent
2. Ability to detect connectivity and supply power to other components	162	4.40	0.88	High Extent
3. Ability to detect electrical bridge in power supplying	162	4.62	0.48	Very High Extent
4. Ability to detect system power pack compatibility	162	4.62	0.64	Very High Extent
5. Ability to detect high voltage problem	162	4.23	0.69	High Extent
6. Ability to detect faulty IC	162	4.48	0.72	High Extent
7. Ability to isolate bad capacitor and other components from the power pack	162	4.59	0.64	Very High Extent

Source: Field Data (2023)

The data presented in Table 4 shows that the mean perceptions of computer maintenance technician in the efficiency of the developed software system for computer maintenance. Apprenticeship on Power pack indicated Very high extent. This is because the result of the responses on each item was greater than 2.50, which was the criterion for the decision rule.

Research Question 5

What is the mean perception of computer maintenance technician on the efficiency of the developed software system for hardware maintenance apprenticeship on hard disk?

Table 5: Mean perceptions of computer maintenance technician on the efficiency of the developed software system for computer hardware maintenance apprenticeship on hard Disk

Items	n	x	Std. Deviation	Remarks
Ability to detect hanging problem	162	4.48	0.77	High Extent
Ability to detect unusual sound from the hard disk	162	4.50	0.62	Very High Extent
Ability to detect wrong connections in the hard disk	162	4.51	0.62	Very High Extent
Ability to detect RAM and ROM faulty signals	162	4.55	0.64	Very High Extent
Ability to detect wrong configuration on the hard disk	162	4.41	0.88	High Extent
Ability to check error using windows xp scan disk tool delivery	162	4.37	0.74	High Extent
Ability to detect power surge in the hard disk	162	4.61	0.66	Very High Extent

Source: Field Data (2023)

The data presented in Table 5 shows that the mean perceptions of computer maintenance technician in the efficiency of the developed software system for computer maintenance apprenticeship on Hard disk indicated very high extent. This is because the result of the responses of the items on each item was greater than 2.50, which was the criterion for the decision rule.

Testing of Null Hypothesis

The following Null Hypothesis were tested at 0.5 level of significance

H_{01}: There is no significance in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on motherboard

Table 6: Summary of t-test Analysis in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on motherboard (df = 160)

S/N	Motherboard	$\bar{x}_1$	$\bar{x}_2$	t-cal	ig.	Dcns.
1.	Ability to use the developed computer maintenance software system for handling motherboard	3.60	3.53	1.16	0.24	NS
2	Ability to detect low energy supply	3.60	3.49	1.83	0.06	NS
3	Ability to detect faulty DOS process	3.60	3.48	2.54	0.42	NS
4	Ability to show and installed IC in the motherboard	3.59	3.47	2.03	0.43	NS
5	Ability to identify processor chips in the motherboard	3.59	3.50	0.59	0.11	NS
6	Ability to detect all possible connections on the motherboard	3.18	3.19	0.32	0.48	NS
7	Ability to detect that the motherboard is coordinating other components	3.05	3.04	0.21	0.29	NS

Source: Field Data (2023) NS = Not significant at 0.05

The result in Table 6 shows the summary of item analysis of difference in responses of technician and apprentice on the efficiency of the developed software system for hardware maintenance apprenticeship on motherboard. Finding from the analysis shows that all the items have probability value greater than 0.05 alpha level. Since the probability value is greater than 0.05 ($P \geq 0.05$), the result is statistically not significant. Hence, the null hypothesis is retained, thus, there is no significant difference on the efficiency of the developed software system for hardware maintenance on motherboard.

H_{02}: There is no significance in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on keyboard

Table 7: Summary of t-test Analysis in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on keyboard (df= 160)

S/N	Keyboard	$\bar{x}_1$	$\bar{x}_2$	t-cal	Sig of t(Pvalue).	Dcns.
1.	Ability to detect no communication between the keyboard and the motherboard	3.54	3.48	1.06	0.28	NS
2.	Ability to detect no signal between the keys and keyboard plates	3.57	3.71	0.64	0.52	NS
3.	Ability to detect functionality	3.63	3.40	3.99	0.32	NS
4.	Ability to detect when there is no keyboard connection	3.82	3.44	1.33	0.61	NS
5.	Ability to identify keyboard language configuration	3.60	3.44	2.65	0.08	NS
6.	Ability to troubleshoot keyboard if not responding	3.18	3.19	-0.32	0.74	NS
7.	Ability to detect keyboard connection	3.05	3.04	0.21	0.82	NS

Source: Field Data (2023) NS = Not significant at 0.05

The result in Table 7 shows the summary of item of item analysis of difference in responses of technician and apprentice on the efficiency of the developed software system for hardware maintenance apprenticeship on motherboard. Finding from the analysis shows that all the items have probability value greater than 0.05 alpha level. Since the probability value is greater than 0.05 ($P \geq 0.05$), the result is statistically not significant. Hence, the null hypothesis is retained, thus, there is no significant difference on the efficiency of the developed software system for hardware maintenance on keyboard

H_{03}: There is no significance in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on monitor.

Table 4: Summary of t-test Analysis in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Monitor (df= 160)

S/N	Monitor	$\bar{x}_1$	$\bar{x}_2$	t-cal	Sig of t(Pvalue).	Dcns.
1.	Ability to detect low voltage in the monitor	3.72	3.60	0.55	0.57	NS
2.	Ability to detect communication between monitor and motherboard	3.55	4.02	1.61	0.10	NS
3.	Ability to detect sharing display fault	3.53	3.60	1.53	0.29	NS
4.	Ability to detect CRT failure	3.53	3.60	1.55	0.24	NS
5.	Ability to detect monitor's sound failure	3.57	3.87	1.39	0.16	NS

6.	Ability to detect VGA card failure	3.22	3.28	0.99	0.32	NS
7.	Ability to isolate bad capacitor and other components from the monitor	3.44	3.64	0.96	0.333	NS

Source: Field Data (2023) NS = Not significant at 0.05

The result in Table 8 shows the summary of item of item analysis of difference in responses of technician and apprentice on the efficiency of the developed software system for hardware maintenance apprenticeship on motherboard. Finding from the analysis shows that all the items have probability value greater than 0.05 alpha level. Since the probability value is greater than 0.05 (P≥0.05), the result is statistically not significant. Hence, the null hypothesis is retained, thus, there is no significant difference on the efficiency of the developed software system for hardware maintenance on monitor.

H_{04}: There is no significance in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Power pack.

Table 9: Summary of t-test Analysis in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Power pack (df = 160)

S/N	Power Pack	$\bar{x}_1$	$\bar{x}_2$	t-cal	Sig of t(Pvalue).	Dcns.
1.	Ability to detect low voltage in the Power pack problem	3.48	3.48	0.04	0.33	NS
2.	Ability to detect connectivity and supply power to other components	3.70	3.71	0.03	0.09	NS
3.	Ability to detect electrical bridge in power supplying	3.56	3.40	2.80	0.16	NS
4.	Ability to detect system power pack compatibility	3.74	3.44	1.05	0.30	NS
5.	Ability to detect high voltage problem	3.60	3.44	2.65	0.15	NS
6.	Ability to detect faulty IC	3.14	3.09	1.27	0.52	NS
7.	Ability to isolate bad capacitor and other components from the power pack	3.15	3.07	1.87	0.08	NS

Source: Field Data (2023) NS = Not significant at 0.05

The result in Table 9 shows the summary of item of item analysis of difference in responses of technician and apprentice on the efficiency of the developed software system for hardware maintenance apprenticeship on motherboard. Finding from the analysis shows that all the items have probability value greater than 0.05 alpha level. Since the probability value is greater than 0.05 (P≥0.05), the result is statistically not significant. Hence, the null hypothesis is retained, thus, there is no significant difference on the efficiency of the developed software system for hardware maintenance on Power pack.

H_{05}: There is no significance in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on hard disk

Table 10: Summary of t-test Analysis in the mean response of technician and apprentice perception on the efficiency of the developed software system for hardware maintenance apprenticeship on Monitor (df = 160)

S/N	Hard disk	$\bar{x}_1$	$\bar{x}_2$	t-cal	Sig of t(Pvalue).	Dcns.
1.	Ability to detect hanging problem	3.84	4.29	1.69	0.09	NS
2.	Ability to detect unusual sound from the hard disk	4.03	3.91	0.41	0.67	NS
3.	Ability to detect wrong connections in the hard disk	3.76	3.95	0.55	0.20	NS
4.	Ability to detect RAM and ROM faulty signals	3.73	3.97	0.72	0.40	NS
5.	Ability to detect wrong configuration on the hard disk	3.84	3.29	0.58	0.11	NS
6.	Ability to check error using windows xp scan disk tool delivery	3.18	3.19	0.32	0.74	NS
7.	Ability to detect power surge in the hard disk	3.05	3.04	0.21	0.09	NS

Source: Field Data (2023) NS = Not significant at 0.05

The result in Table 10 shows the summary of item of item analysis of difference in responses of technician and apprentice on the efficiency of the developed software system for hardware maintenance apprenticeship on motherboard. Finding from the analysis shows that all the items have probability value greater than 0.05 alpha level. Since the probability value is greater than 0.05 ($P \geq 0.05$), the result is statistically not significant. Hence, the null hypothesis is retained, thus, there is no significant difference on the efficiency of the developed software system for hardware maintenance on Power pack.

Discussion of Findings

Develop software system and motherboard maintenance

The analysis of the responses to research question 1 revealed that developed software system for motherboard maintenance is positive. Analysis of the perception of technicians and apprentices towards the developed software system is accepted as an indicator of positive contribution to system maintenance for use in Uyo Metropolis. The result can be interpreted that apprentice and technicians realized the benefits of developed software use for maintenance delivery. The finding is in agreement with the observation of Davis, (2017) who sought for a more efficient mother board fault detection system and recommended the use of intelligent system for fault detection to ensure hardware reliability.

Develop software system and keyboard maintenance

Secondly the study findings showed that the analysis of the responses to research question 2 presented revealed that the developed software system for keyboard maintenance is positive. Analysis of the responses of technicians and apprentices towards the developed software system is accepted as an indicator of positive change in handling hardware maintenance problems in Uyo Metropolis. The result can be interpreted that apprentice and technicians realized the benefits of developed software use for maintenance delivery. The finding is in agreement with the observation of Wig (2017) who identified the major causes of Keyboard failure consisting of connection issue, bent or broken pin, updating notifications, hardware problem, system problem and bottom line. Wig (2017) suggested the use of artificial intelligence system for diagnosis of systems at assembling of system level to ensure error free design.

Develop software system and monitor maintenance

Thirdly the study findings showed that the analysis of the responses to research question 3 presented revealed that developed software system for monitor maintenance is positive. Analysis of the perception of technicians and apprentices towards the developed software system is accepted as an indicator of positive attitude in Uyo Metropolis. The result can be interpreted that apprentice and technicians realized the benefits of developed software use for maintenance delivery. The finding is in agreement with the observation of Henry, (2017) who investigated the common monitor problems and recommended the need for more efficient monitors by proffering solution to those challenges.

Develop software system and power pack maintenance Fourthly the study findings showed that the analysis of the responses to research question 4 presented revealed that developed software system for power pack maintenance is positive. Analysis of the attitude of technicians and apprentices towards the developed software system is accepted as an indicator of positive attitude in Uyo Metropolis. The result can be interpreted that apprentice and technicians realized the benefits of developed software use for maintenance delivery. The finding is in agreement with the observation of Dong-Li, (2019), Sarah and Yasin, (2020) who all investigated the causes of power pack failure and recommend for a more efficient power pack design. Dong-Li, (2019) investigated the power pack problems that normally lead to blowing of the system and inability to stabilize power for each performance and operation of the computer. While Sarah and Yasin (2020) investigated the most obvious sign of a faulty power supply.

Develop software system and hard disk maintenance

The study findings showed that the analysis of the responses to research question 5 presented revealed that developed software system for keyboard maintenance is positive. Analysis of the attitude of technicians and apprentices towards the developed software system is accepted as an indicator of positive attitude in Uyo Metropolis. The result can be interpreted that apprentice and technicians realized the benefits of developed software use for maintenance delivery. The finding is in agreement with the observation of Henry, (2017) who identified the causes of hard disk failure to including: human error, hardware failure, firmware corruption, media damage, heat, water damage, power issues and mishaps recommended for solutions and more efficient system. Hard disk can be caused by a number of different reasons including, Head crash. Virus attacks or malware, Poor power supply, Corrupted operating systems and damaged blocks or worn out.

Conclusion

In conclusion the study shows that the designed intelligent system is highly efficient and proffers better performance in resolving common challenges confronted in existing computer systems. It is believed that it will provide the meet and exceeds users requirements for a modern computer system. Also experts and researchers shall derived relevant information which will serve as future innovative works.

Educational Implications of Findings

i. The design of the developed system software has contributed immensely as the foundation for young programs in the university who are starting their programming skill.
ii. The computer maintenance Technicians would now have a simplified ways of detecting computer fault through the use of the developed software system.
iii. The study is going to serve as a basis for other develop more improve intelligent system that solve complex problem that the present software could not address.
iv. Other researchers will be using the mile stone of this work to serve as a reference material for further researches.
v. Government agencies and other stakeholder can as well recommend further development of the design into training modules for teaching computer maintenance in Technical colleges and other skill acquisition centers at the state and federal level.

Recommendations

Based on the findings of the study, the following recommendations are here by proffered

1. There is the need for training of computer professionals with newer innovative technology to help proffer solution to many challenges experienced in the use of computer systems by Government Agencies for skill development.
2. The state and federal government and other relevant Educational stakeholders should provide a Modern and comprehensive curriculum on computer science and development to help produce experts with modern skills
3. It is also essential that Apprenticeship training be properly monitored and evaluated based on Modern computer technology as to enhance overall technology development in the country by various Federal Government.
4. There is also the need to provide funding and support towards the acquisition of Modern computer technology by Federal Government.

5. From the outcome of this study and the level of perception demonstrated by technician and apprentices, it is enough evidence that this work has and will contribute immensely to the challenges faced by technician in resolving computer maintenance issues. Also, when introduce in technical colleges it is going to be a model of development for other technology innovations.

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