UNIVERSITY OF PORT HARCOURT

INFORMATION TECHNOLOGY: THE ALBATROSS OF OUR TIME

An Inaugural Lecture

By

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DEDICATION

This inaugural lecture is dedicated to
my father, Late Pastor Herbert Njoku Nwachukwu,
my mother, Late Mrs. Christiana Nmaji Nwachukwu, and
my Elder brother, Late Mr. Obed A. H. Nwachukwu,
who were great lovers of child education.

ACKNOWLEDGEMENTS

Mr. Vice-Chancellor Sir, this lecture will not be complete if I do not acknowledge those who have contributed in one way or the other to make it possible.

While thanking God for all his mercies, I will like to express my indebtedness to my home front. My wife Blessing has utilized her Uniport Management degree to manage me all these years. My children Tony, Uche and Oge have been most understanding, most loving and most caring. They have been my brothers and sister as well.

Professor S.N. Okiwelu has had tremendous influence on me since I met him as his fag at Government Secondary School Owerri. I highly appreciate having him in my life. I am grateful to Government Secondary School Owerri that laid the foundation for what my achievements are today, having enjoyed the School Scholarship from Class two through to Upper Six with all expenses paid. The Old Boys Association, Government Secondary Owerri are always there to be counted. They are a rare breed. I am also grateful to the Federal Republic of Nigeria for her Scholarships at both the Undergraduate and Post Graduate levels.

I cannot forget Eng. Mezi-Okoye and his amiable wife Meg who gave me free access to their house through their back porch from where I tapped their telephone line to enable me have my first personal Internet connectivity. I had to install a metal gate through which I could enter their house even when nobody else was at home! Their magnanimity and trust in me were proverbial. I am grateful to the whole Mezi-Okoye clan.

I am very grateful to Bartholomew Eke for his useful comments while proof reading this lecture. The Computer Science Department family has been most supportive. My colleagues, students and the University community at large have made staying at Uniport worthwhile. I am grateful.

Vice-Chancellor, Sir,
Members of Governing Council,
Past Vice-Chancellors,
Deputy Vice-Chancellors,
Registrar and other Principal Officers of the University,
Provost, College of Health Sciences,
Dean, School of Graduate Studies,
Deans of Faculties,
My Fellow Professors and other Academic Colleagues,
Directors and Heads of Departments,
Staff and Students of the University of Port Harcourt,
Distinguished Guests and Friends,
Members of the Press
Ladies and Gentlemen,

I very much welcome you to this inaugural lecture titled Information Technology: The Albatross of Our Time.

It is with the deepest sense of humility that I stand before you to deliver the first inaugural lecture in the Department of Computer Science University of Port Harcourt. This also happens to be the first inaugural lecture in Computer Science in the Eastern and the South-South states of Nigeria. The journey to my Professorship started in 2003/2004 academic session, matured in 2005 and promptly processed and concluded by 2008 with effect from June 2005. Vice-chancellor sir, I am very grateful.

This inaugural lecture affords one the opportunity to share with this distinguished audience ones academic achievements and concerns, and articulate in non technical terms the road map for the future. One is actually being inaugurated to produce and deliver more lectures that break new grounds and attain greater academic laurels.

WHY HAVE WE CHOSEN THIS TOPIC?

Information technology, (IT) whose heart beat is computer science has become so relevant in our 21st century society that it cannot be ignored. University of Port Harcourt has gone a very long way. When we joined Uniport in September 1983 the University had only one PDP 11/70 computer with 5 terminals. At that time the University environment appeared to have been scared by the presence of computers. Very few academic staff were computer literate. Apathy for Computer Science was vividly demonstrated by the banning of any research proposal that included the purchase of a computer. This ban continued until 2003 when research grants dried up. You can then imagine the type of research we were expected to carry out! Some of us had to make sacrifices to enable us acquire PC's for our survival.

When in 1999 I used my professional contacts to get DANALEC to donate the first internet facility to Uniport, members of council had to be invited to witness it!!

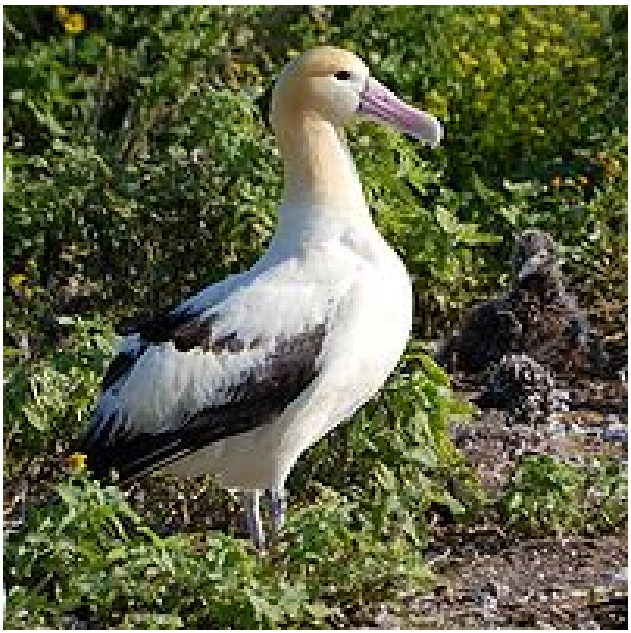
Today however, the present administration is favourably disposed towards computerization and IT development. Every academic staff has been encouraged to have a computer in his or her office. We understand also that the Senate Building which will soon be commissioned will be a high-tech IT-friendly building.

I am standing before you today like a priest delivering a sermon to a congregation of worshipers. You cannot raise your hand to ask a question and you are not allowed to make any comment even when you vehemently disagree

with what I say. I will however, try to answer some questions which I presume you would have asked!

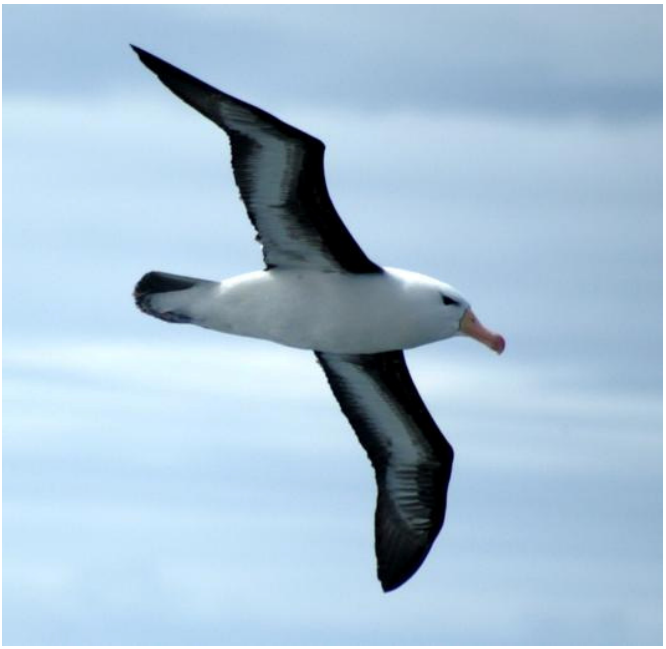
WHAT IS ALBATROSS?
Albatross can be looked at as either a bird or a Metaphor.

Albatross as a Bird
Albatross, of the biological family Diomedeidae, is a large seabird allied to the procellariids, storm-petrels and diving-petrels. Albatross is amongst the largest of flying birds, and the great albatross (genus *Diomedea*) has the largest wingspans of any extant bird. Albatrosses are highly efficient in the air, using dynamic soaring and slope soaring to cover great distances with little exertion. They feed on squid, fish and krill by either scavenging, surface seizing or diving. (Wikipedia, 2009)



An Albatross: Courtesy: **Wikipedia, http://en.wikipedia.org/wiki/File:Short_tailed_Albatross 1.jpg**

In other words Albatross as a bird is very large, highly efficient in its environment, (air), uses robust dynamic techniques, (technologies), has a multiplicity of sources (inputs) of food (Data), and a diversity (different techniques) of capturing its food (data).



An Albatross in flight: Courtesy **Wikipedia, http://en.wikipedia.org/wiki/File:Short_tailed_Albatross 1.jpg**

Albatross as a metaphor

According to Webster dictionary (2009), Albatross is

a: Something that causes persistent deep concern or anxiety
b**:** Something that greatly hinders accomplishment**.**

Some questions need to be answered. Is Information Technology an Albatross of a bird or is it the metaphor albatross? I hope that you will be able to answer these questions before you leave here.

WHAT IS INFORMATION TECHNOLOGY?

First definition

Information Technology (IT) is a general term that describes any technology that helps to produce, manipulate, store, communicate, and/or disseminate information. With this definition, my grandfather who was a very successful farmer must have used Information Technology. He had the data at his finger tips, of the different types of yams, and which farm land was best suited for each yam specie. He used all the data gathered from years of experience and stored in his memory, to make decision on what to plant, when to start planting and where to plant. He knew when to start bush clearing and planting of crops at his backyard at Okpulo Umuanum, and when to start at Egbelu Umuanum some two kilometers away.

Second definition

Information technology as defined by the Information Technology Association of America (ITAA), is "The study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware." IT deals with the use of electronic computers and computer

software to convert, store, protect, process, transmit, and securely retrieve information (Wikipedia 2008).

We notice the inclusion of computer in the latest definition of IT. What is a computer? A computer is an electronic machine that accepts data as Input, Processes it, and gives Information as Output.

In fact modern IT is largely dependent on developments in computer and computing technologies (both hardware and software).

The information technology umbrella can be quite large (may be larger than that of an Albatross), covering many fields. IT professionals perform a variety of duties that range from installing applications to designing complex computer networks and information databases. A few of the duties that IT professionals perform may include data management, networking, engineering computer hardware, database and software design, as well as the management and administration of entire systems. Thus when computer and communications technologies are combined, the result is Information Technology

IMPORTANCE OF INFORMATION TECHNOLOGY

It is impossible to imagine an advanced society without considering information technology (Mehdi, 2005). The need for software and Software Engineering techniques grows increasingly every day (Nwachukwu and Eke 2008b). As noted by the U.S. President's Information Technology Advisory Committee, software is the new physical infrastructure of the information age. It is fundamental to economic success, scientific and technical research, and national security (Bruegge et al, 2000). It is rare to find a

field not influenced by information technology. Is IT not the Albatross of a bird?

It has been recognized that information systems knowledge is vital for managers because most organizations require IT in order to survive and succeed (Nwachukwu 1983, Laudon et al 2005, Nwachukwu and Uzoh 2008c). Worldwide changes have altered the business environment. One of the main changes is the transformation of industrial economies and societies into knowledge and information-based service economies. Whereas highly advanced countries such as Japan, the USA, Germany, United Kingdom, Canada, and other major industrial countries are being transformed from industrial economies to knowledge and IT-based service economies, manufacturing has been moving to low-wages countries such as Indonesia, China, and Malaysia. In these advanced societies, knowledge and information are key parts in creating new products, services, jobs and wealth. Nigeria is in a position to join in the creation of these IT-based new products, services, jobs and wealth.

According to the US Department of Commerce (U.S., 2002)), knowledge and information work account for 60 percent of the American gross national product and about 55 percent of the labour force. According to a source (U.S., 2003), between 1980 and 2003, private business investment in information technology grew from 19 percent to more than 35 percent. As the worldwide economic melt down deepens, companies and indeed the whole world are turning to IT for rescue.

Career in Information Technology

According to the 2009 Robert Half International Salary Guide, careers in business, IT, and law are among top three fields expected to yield top careers in the coming year

(*Gray 2009)*. There is no doubt that both students and parents will be interested in the areas of study that will lead to a career in Information Technology. The shortest path is a degree in Computer Science. A second path is a degree in Electronics/Electrical Engineering, Software Engineering, Information Technology, or Information Systems. A third path is a PG Diploma in Computer Science. The following are top ten reasons why young people should take up a career in Information Technology (Nwachukwu 2008):

1. IT has become part of everything we do!

   IT is part of everything that touches our lives from the cars we drive, to the movies we watch, to the ways businesses and governments deal with us. Understanding different dimensions of IT is part of the necessary skill set for an educated person in the 21st century. Whether you want to be a scientist, develop the latest killer application, or just know what it really means when someone says "the computer made a mistake", studying IT will provide you with valuable knowledge.

2. Expertise in IT enables you to solve complex, challenging problems.

   IT is a discipline that offers rewarding and challenging possibilities for a wide range of people regardless of their range of interests. Computing for example, requires and develops capabilities in solving deep, multidimensional problems requiring imagination and sensitivity to a variety of concerns.

3. IT enables a person to make a positive difference in the world.

Computing drives innovation in the sciences (human genome project, AIDS vaccine research, environmental monitoring and protection just to mention a few), and also in engineering, business, entertainment and education. If you want to make a positive difference in the world, you will like to pursue a career in IT.

4. IT offers many types of lucrative careers.

IT jobs are among the highest paid and have the highest job satisfaction. Computing for example is very often associated with innovation, and developments in computing tend to drive IT. This, in turn, is the key to national international competitiveness. The possibilities for future developments are expected to be even greater than they have been in the past.

5. IT jobs are here to stay, regardless of where you may be located.

In Nigeria as in other parts of the world there actually are more IT jobs than qualified people to fill them. In the United States for example. IT employment was 17% higher in 2004 than in 1999. The Bureau of Labor Statistics says computing has the greatest potential for new jobs through 2014.

6. Expertise in IT helps you even if your primary career choice is something else.

Having an IT training for example, will provide you with a foundation of knowledge, problem solving and logical thinking that will serve as a competitive advantage to you in your career, in whatever field you choose.

7. IT offers great opportunities for true creativity and innovativeness.

The ability to create high-quality IT solutions is a highly creative activity, and IT supports creative work in many other fields. The best solutions in computing exhibit high levels of elegance and beauty.

8. IT has space for both collaborative work and individual effort.
Although IT is often about being part of a team that requires people with many different kinds of skills, yet there is also plenty of space for individual flair and imagination.

9. Computing Science, an important component of IT, is an essential part of well-rounded academic preparation.

An increasing number of universities and employers see successful completion, for example, of a computer science course as a sign of academic well-roundedness.

10. Future opportunities in IT have no boundaries.

HISTORICAL DEVELOPMENT OF COMPUTERS

Let us briefly look at the historical development of computers. It is impossible to pinpoint the inventor of the computer. The raw fact is that many inventors contributed to the history of computers as we know them today. This is mainly because a computer is a complex piece of machinery which is made up of many parts, each of which can be considered a separate invention (Bellis 2007), Table 1 gives a highlight of monumental historical landmarks in the development of computers.

Table 1: Historical development of computers.

Computer History Year/Enter	Computer History Inventors/Inventions	Computer History Description of Event
1936	Konrad Zuse - **Z1 Computer**	First freely programmable computer.
1942	John Atanasoff & Clifford Berry **ABC Computer**	Who was first in the computing biz is not always as easy as ABC.
1944	Howard Aiken & Grace Hopper **Harvard Mark I Computer**	The Harvard Mark 1 computer.
1946	John Presper Eckert & John W. Mauchly **ENIAC 1 Computer**	20,000 vacuum tubes later.
1948	Frederic Williams & Tom Kilburn **Manchester Baby Computer & The Williams Tube**	Baby and the Williams Tube turn on the memories. (Williams believed to have written first computer program).
1947/48	John Bardeen, Walter Brattain & Wiliam Shockley **The Transistor**	No, a transistor is not a computer, but this invention greatly affected the history of computers.
1951	John Presper Eckert & John W. Mauchly **UNIVAC Computer**	First commercial computer & able to pick US presidential winners.

1953	International Business Machines **IBM 701 EDPM Computer**	IBM enters into 'The History of Computers.
1954	John Backus & IBM **FORTRAN Computer Programming Language**	The first successful high level programming language.
1955 (In Use 1959)	Stanford Research Institute, Bank of America, and General Electric **ERMA and MICR**	The first bank industry computer - also MICR (magnetic ink character recognition) for reading checks.
1958	Jack Kilby & Robert Noyce **The Integrated Circuit** (IC)	Otherwise known as 'The Chip'
1962	Steve Russell & MIT **Spacewar Computer Game**	The first computer game invented.
1964	Douglas Engelbart **Computer Mouse & Windows**	Nicknamed the mouse because the tail came at the end.
1969	**ARPAnet**	The original Internet.
1970	**Intel 1103 Computer Memory**	The world's first available dynamic RAM chip.
1971	Fagin, Hoff & Mazor **Intel 4004 Computer Microprocessor**	The first microprocessor.
1971	Alan Shugart &IBM **The "Floppy" Disk**	Nicknamed the "Floppy" for its flexibility.
1973	Robert Metcalfe & Xerox **The Ethernet Computer Networking**	Networking.

1974/75	**Scelbi & Mark-8, Altair & IBM 5100 Computers**	The first consumer computers.
1976/77	**Apple I, II & TRS-80 & Commodore Pet Computers**	More first consumer computers.
1978	Dan Bricklin & Bob Frankston **VisiCalc Spreadsheet Software**	Any product that pays for itself in two weeks is a surefire winner.
1979	Seymour Rubenstein & Rob Barnaby **WordStar Software**	Word Processors.
1981	IBM **The IBM PC - Home Computer**	From an "Acorn" grows a personal computer revolution
1981	Microsoft **MS-DOS Computer Operating System**	From "Quick And Dirty" comes the operating system of the century.
1983	**Apple Lisa Computer**	The first home computer with a GUI, (graphical user interface)
1984	**Apple Macintosh Computer**	The more affordable home computer with a GUI.
1985	**Microsoft Windows**	Microsoft begins the friendly war with Apple.
1990	**Microsoft Integrates** Office	Desktop computing becomes integrated with PC/OS

1994	**Microsoft Windows Operating system**	Windows operating system becomes full fledged operating system
1995	**Microsoft Internet explorer gets to NT OS**	World wide Web technology gets boost
1999	**Smart phones with OS**	Data processing capabilitie incorporated in Smart phones
2000	**Micro-coding computing**	Ipods, Smart phones, newer networking technology
2005	**Cloud-top computers**	Computers with server-side processing capability
Expected	**Ubiquitous Robots**	Humanoid robots with self replicating capability
Expected	**Ubiquitous Computer systems**	One person many computers seamlessly connected in a U-space using 4G wireless communication system

Source: Mary Bellis – up to 1985, with personal updates up to 2005.
http://inventors.about.com/library/blcoindex.htm

It is to be observed that Mary Bellis' table terminated in 1985. The development of a full-fledged Microsoft Windows operating system and the demand for a multiplicity of applications software opened a Pandora of activities including Web-based applications (Nwachukwu and Simon-Hart 1986, Adiele and Nwachukwu 2001), Software Engineering (Bruegge and Dutoit 2000, Nwachukwu and Umoh 2007, Nwachukwu and Eke 2008a). A lot of effort has also been put in improving wireless communication systems (Nwachukwu and Nlerum 2002, Nwachukwu and Nlerum 2003), and computer Networks (Nwachukwu 1999).

COMPUTER INFECTION

A computer could be sick and the major contributors to computer illness are Virus, Worms, and Trojan Horse. Although the words, Virus, Worm and Trojan Horse are used interchangeable, they are not the same, even though they are all malicious programs that can cause damage to a computer (Real, 2007).

Virus

A computer virus will normally attach itself to a program or file through which it spreads from one computer to another and leaving infections as it travels. The computer virus is just like that of a human virus, some viruses may cause only mild annoying effects. Others may damage a computer file, software, or even hardware.

A major distinguishing characteristic of a virus is that in virtually all cases it is attached to an executable file. (A file with extension exe)

The implication of this is that a virus may exist in your computer but it cannot infect it until you run or open the

malicious program. It is very important to recognize the fact that a virus cannot be spread if there is no human action.

In many instances, people spread a computer virus unknowingly, by sharing an infected file or by sending e-mail with a virus as attachment in the e-mail.

Worm

A worm is similar to virus by design. However, a worm spreads from computer to computer without any human action. It takes advantage of file or information transport features on a computer system and travels unaided. It is capable of replicating itself on a computer system. Thus instead of a computer sending single worm it could send thousands of copies of itself. This could create a devastating effect. Consider a scenario where a worm sends a copy of itself to every person in your e-mail address book. The worm then replicates and sends itself out to every person listed in each of the receiver's address book, and so on. The resultant effect is that the worm may consume so much system memory or network bandwidth that it could result in individual computers, network servers, and web servers stopping to respond. Some worms can even be designed to allow malicious users to take control of your computer.

Trojan Horse

The Trojan Horse appears to have as much trickery as the mythological Trojan Horse, (Wilipedia_2, 2009). At first sight a Trojan Horse will appear to be useful software but will actually do damage as soon as it is installed or run on a computer. People are usually tricked into opening them because they appear to be legitimate software or files from legitimate source. As soon as a Trojan Horse is activated on a computer the consequence can vary. Some are

designed to be more annoying than malicious, such as changing your desktop or adding some silly active desktop icons. Others can cause serious damage by deleting files and destroying information on your computer. Some Trojan Horses are also known to have created a “backdoor” on computers. Such a backdoor gives malicious users access to your computer, thereby allowing confidential information to be compromised. Trojan Horse, unlike viruses and worms, do not self-replicate nor do they infect other files.

Blended Threats

> **“Did You Know...**
> CodeRed, a blended threat, launched DoS attacks, defaced Web servers, and its variant CodeRed II, left Trojan horses behind for later execution. CodeRed was processed in memory — not on a hard disk — allowing it to slip past some anti-virus products. Computer Economics has estimated the worldwide cost of CodeRed at $2.62 billion dollars.”
> [Source: *Symantec Web site*]

Blended threat is a sophisticated attack that combines some of the worst aspects of Trojan Horse, Worms and Viruses, unto a single threat. A blended threat can use a server and internet vulnerabilities to initiate, transmit, and spread an attack. The following are the characteristics of blended threats;

- Can cause harm to infected system or network
- Can propagate using multiple methods
- Attack can come from multiple points
- Can exploit vulnerabilities

In a typical attack, one payload would not only launch a DoS attack, it could also install a backdoor, and even damage your system.

Protecting Computer Against Viruses, Worms, and Trojan Horses.

There are necessary steps that should be taken to protect a computer from malicious attacks. They include:

- Updating of the operating system (O.S). This is very important if the computer is running a Microsoft windows operating system

- Installing antivirus software followed by frequent download of updates to ensure that the software has the latest fixes for new viruses, worms and Trojan Horse

- Running full disk scans periodically.

- Installing firewalls

Firewall

A firewall is a protective system that lies between a computer network and the internet (Real 2004). It prevents unauthorized use and access to your computer and your network. If your computer has access to the outside world via the internet, you need to have firewall to protect your network, individual computer, and data in your system.

A firewall can either be hardware or software. Many routers these days come with hardware firewalls.

Any PC that is connected to the internet should have software firewall. Some antivirus software come with software firewalls as standard.

There are vast differences between a software and hardware firewall. The best protection for a computer and network is to use both, since each offers different but much needed security features and benefits. Regular updating of firewalls and operating systems is necessary for optimal protection of a computer system.

EVOLUTION OF INTERNET

Internet is an acronym for International Network. It is a network of networks spanning international boundaries (Nwachukwu and Abumere 2003).

Internet Time Line

"In the Beginning, ARPA created the ARPANET.

And the ARPANET was without form and void.

And darkness was upon the deep.

And the spirit of ARPA moved upon the face of the network,

And ARPA said, 'Let there be a protocol,' and there was a protocol.

And ARPA saw that it was good.

And ARPA said, 'Let there be more protocols,' and it was so.

And ARPA saw that it was good.

And ARPA said, 'Let there be more networks,' and it was so."

- *Danny Cohen*

This Internet Timeline began in 1962, before the word 'Internet' was invented. The world's 10,000 computers were primitive, although they cost hundreds of thousands of dollars. They had only a few thousand words of magnetic core memory, and programming them was far from easy.

In the United States, data communication over the phone lines was an AT&T monopoly. The 'Picturephone' of 1939, shown again at the New York World's Fair in 1964, was still AT&T's answer to the future of worldwide communications.

But the four-year old Advanced Research Projects Agency (ARPA) of the U.S. Department of Defense, laid the groundwork for what became the ARPANET and, much later, the Internet.

By 1992, when this timeline ends,

- the Internet has one million hosts
- the ARPANET had ceased to exist
- computers were nine orders of magnitude faster
- network bandwidth was twenty million times greater.
- Internet has been borne!

The development of Internet opened another Pandora of activities in Software Engineering (Nwachukwu et al 2006b, Nwachukwu and Eke 2008a, 2008b), and in Web-based

applications (Nwachukwu and Umoh 2007) and in Cyber security (Nwachukwu 2000a).

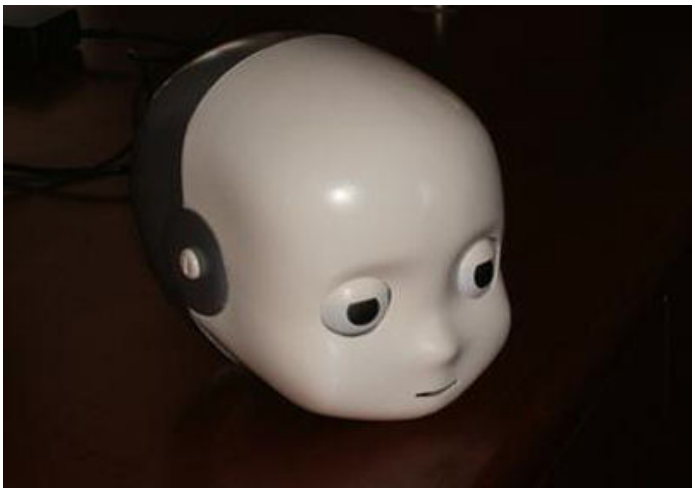
PRESENT STATE OF INFORMATION TECHNOLOGY

"Woman watches home invasion on webcam

Story Highlights

- *At work in Fort Lauderdale, a woman checked on home and saw unknown men*
- *She had installed camera after her home was burglarized before*
- *Woman called 911 to give play-by-play of incident*
- *Four men were charged in the home invasion" (CNN_1, 2009).*

"World-leading robot makes UK debut in Manchester



iCub Robot
Courtesy: Manchester University Alumni e-news, April 2009.

Europe's most advanced humanoid robot has gone on show at The University of Manchester - its very first public appearance in the UK.

The prototype iCub - which is being built in Italy - moves in an astonishingly lifelike way, and is already capable of eye and head motion, leg movement and object recognition. RobotCub, the developers behind iCub, hope to learn more about human cognition during the 5 year project duration" (Manchester 2009).

TRENDS IN INFORMATION TECHNOLOGY

Ubiquitous Computing

Ubiquitous computing (Ubicomp) was coined by Mark Weiser in his paper "open house" (Web_1, 2009). He proposed a paradigm shift in Information Technology in terms of relationship between technology and human beings. This proposal appears to have fueled the ubiquitous revolution. This revolution has manifested itself in such new multidisciplinary research areas as ubiquitous robotics and ubiquitous computer systems.

Ubiquitous Robots

Ubiquitous robots represent the third generation of robotics. The first generation was the era of industrial robots and the second the personal robot. An Ubiquitous Robot follows the general concepts of ubiquitous computing. It is designed to be seamless, calm, and context aware. An Ubiquitous robot can connect to and be transmitted to any device, at any time and at any place within the ubiquitous space (u-space), by maintaining its own unique IP address. It is context aware and can automatically and calmly provide services to the user.

There are three recognizable forms of robots – the software robot (Sobot), the embedded robot (Embot), and the mobile robot (Mobot).

Traditionally robot is defined as the “intelligent connection of perception to action” (Web_1, 2009). However, ubiquitous robotics redefines the connection of the three components, Intelligence, perception, and action by letting them be manifested as the Sobot, the Embot, and the Mobot respectively. The interconnection is through a network and the integration is done using the middleware in the ubiquitous space (U –space), (Kim et al 2004a). The network is powered by 4G (fourth Generation) mobile communication system.

While Sobots provide intelligence to this system, distributed embedded sensors ensure that the Sobots possess context aware perceptive capabilities (Kim et al 2002, Kim et al 2004b). Finally, Mobots provide services for requests in the physical domain. Embots collect and synthesize sensory information through the detection, recognition and authentication of users and other robots. Mobots proceed to act by providing the general users with integrated services. Middleware enables the Ubibot to interact and manage data communication reliably without disrupting the protocols in the u-space.

All these are made possible by such networking technologies as IPv6 format and 4G communication. Ubiquitous robot will therefore be able to understand what the user needs, even without the user giving a direct command.

Research and development of ubiquitous robots are here with us. A typical example is the *i*Cube robot, being

displayed at my Alma Mata, The University of Manchester, England.

UBIQUITOUS COMPUTERS

Mainframe	(One Computer, Many People)
PC	(One Person, One Computer)
Ubiquitous Computing	(One Person, Many Computers)

Ubiquitous computer system is a post-desktop model of human-computer interaction in which information processing has been thoroughly integrated into everyday objects and activities. In the course of ordinary activities, someone "using" ubiquitous computing engages many computational devices and systems simultaneously, and may not necessarily even be aware that they are doing so (Wkipedia_3, 2009). This model is a tremendous advancement from the desktop paradigm or such specialized computers as Signal Processors (Nwachukwu, 1978), and Array Processors (Nwachukwu, 1980, Nwachukwu 1985, and Nwachukwu 2000), since it involves integrating computers seamlessly into the world at large. Ubiquitous computing is roughly the opposite of virtual reality. While virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out here in the world with people. Ubiquitous computing is an integration of human factors, computer science, engineering, and social sciences.

The technology required for ubiquitous computing comes in three parts:

- Cheap, low-power computers that include equally convenient displays,

- A network that ties them all together, and
- Software systems implementing ubiquitous applications.

Current trends suggest that the first requirement will easily be met. Flat-panel displays containing 640x480 black-and-white pixels are now common. This is the standard size for PC's and is also about right for television. As long as laptop, palmtop and notebook computers continue to grow in popularity, display prices will fall, and resolution and quality will rise. We expect that a 1000x800-pixel high-contrast display will be a fraction of a centimeter thick and will weigh perhaps not more than 100 grams. Technology for small battery that will provide several days of continuous use is already available. Power failures and irritating power fluctuations may not be relevant factors in their operations and use.

Auxiliary storage devices will augment the memory capacity. Already less than match-box size removable flash drives that store Gigabytes of information are readily available, and terabyte storage will be common. Such abundant space will allow radically different strategies of information management.

As at today there are no operating systems that perform well with the diversity of inputs to be found in an embodied virtuality of Ubiquitous computer system. A more general solution for ubicomp will require changing the protocols with which application programs and windows interact.

The network connecting these ubiquitous computers has its own challenges. On the one hand, data transmission rates

for both wired and wireless networks are increasing rapidly. Access to gigabit-per-second wired nets is already possible.

On the other hand, the transparent linking of wired and wireless networks is still a problem to be solved. Although some stop-gap methods have been developed, yet new communication protocols that explicitly recognize the concept of machines that move in physical space must be developed. Furthermore the number of channels envisioned in most wireless network schemes is still very small, and the range large (50-100 meters).The total number of mobile devices is severely limited. 4G mobile communication systems, which will be discussed later, will be a *sine qua non* requirement for the success of Ubiquitous computing.

Ubicomp technologies would require a mobile device to have three different network connections: tiny range wireless, long range wireless and very high speed wired. A single kind of network connection that can somehow serve all three functions is a challenge for Ubicomp development.

Security of information in ubicomp is more daunting than present desktop situation. Fortunately, cryptographic techniques already exist to secure messages from one ubiquitous computer to another and to safeguard private information stored in networked systems (Nwachukwu 2000a, Asagba and Nwachukwu 2005, Nwachukwu et al 2006b). If designed into systems from the outset, these techniques can ensure that private data does not become public. A well-implemented version of ubiquitous computing could even afford better privacy protection than exists today. As an example, schemes based on digital pseudonyms could eliminate the need to give out items of personal information that are routinely required these days.

When almost every object either contains a computer or can have a tab attached to it, obtaining information will be trivial.

CONNECTIVITY IN UBIQUITOUS COMPUTING

The success of ubiquitous computing depends on eliminating the problems associated with current 3G mobile communication systems (Nwachukwu and Nlerum 2002, Nwachukwu and Nlerum 2003). The approaching 4G mobile communication systems are projected to solve outstanding problems of 3G systems and to provide a wide variety of new services, from high-quality voice to high-definition video to high-data-rate wireless channels. The term 4G is used broadly to include several types of broadband wireless access communication systems, not only cellular telephone systems. One of the terms used to describe 4G is MAGIC—Mobile multimedia, Anytime anywhere, Global mobility support, Integrated wireless solution, and Customized personal service (Jivesh et al, 2007). The 4G systems will not only support the next generation of mobile services, but also will support the fixed wireless networks.

4G Mobile Communication Systems

Technically, 4G stands for one integrated, IP-based environment for all telecommunications requirements including voice, video, broadcasting media and Internet, that utilizes both fixed and wireless networks. Using intelligent terminals, the user can get simple broadband access to a range of services that take into account his personal preferences and context. By using adhoc networking, user's mobile terminals can form networks among themselves or with the terminals of third parties. Throughout all this complex procedures, the user always maintains full control over privacy, security risks and costs.

The Goal of 4G

4G must be clearly more and better than 3G in terms of services, applications, and technology. As a comparison, 4G is not a combination of High Speed Uplink/Downlink Packet Access (HSUPA/HSDPA) or Wireless LAN (WLAN). The relationship between 3G and 4G can be captured by the following inequalities (Jivesh et al 2007) :

3G + HSDPA + HSUPA < 4G
3G + WLAN < 4G
3G + HSDPA + WLAN < 4G

Table 1 compares the different wireless communication technologies.

Table I: Comparison of Wireless Communication Technologies

	1G	2G	2.5G	3G	4G
Transmission	Analogue	Digital	Digital	Digital	Digital
Architecture		Circuit Switch	Packet Switch	Circuit and Packet Switch	Packet Switch
Speeds		9.6 to 14.4 Kbps	64 to 144 Kbps	384 Kbps to 2Mbps	100 to 1000 2Mbps

It can be observed that 3G networks are inadequate to accommodate WLANS as access networks which offer data rates of 11Mbps. The goal of 4G will be to replace the entire core of cellular networks with a single worldwide cellular

network completely standardized based on the IP for video, Voice over IP (VoIP) and multimedia services.

Desirable Characteristics of 4G

4G does not have as yet an established standard. Its standards are adhoc. However, the desirable characteristics of 4G include

- Carrier frequency: 5GHz.
- Channel bandwidth /operator: 50MHz
- Target data rate: 100 to 1000 Mbits/s.
- High bandwidth efficiency: 2 to 20bitsHz
- Channel is assumed to be extremely frequency-selective.
- Ubiquity: Seamless Communication, Next-generation internet supporting IPv6, Mobile over IP.
- Lower system cost: 1/10-1/100 lower than that of 3G, Infrastructure cost: 1/10 lower than that of 3G.
- Multiplexing options: single-carrier (SC), multi carrier (MC) (including orthogonal frequency- division multiplexing (OFDM)).
- Multi-access options: TDMA, CDMA.

Current Merits of 4G

The following illustrate some merits of 4G:

- Presently, 4G is unregulated, it requires no license. Hence, an ease of experimentation.

- 4G will be completely wireless thereby requiring no ditch digging. It will completely by-pass any low capacity wired connection.

- Accessibility of multimedia services to users any where, any place, and at any time.

- 4G will be cheap, thereby, allowing carriers to upgrade inexpensively.

- Evolution of new types of input/output devices for fast data exchange (glasses, displaying 3D virtual world, collapsible screens, e-paper, and voice and handwriting recognition). Thus there will be growth in markets involving PCs, consumer electronics, microprocessors and software.

- Increased competition amongst applications and service providers for prospective users.

- Quality of Internet wireless access will not be inferior, in any way, to wired access.

- It follows that the mobile networks should be stable and dependable, and should be available 24 hours per day.

- Conception of a global telecommunication system, for example, a telephone or data call from a isolated place such as desert or Niger Delta Creek, to an advanced city will be trouble free (satellite-based backbone telecommunication systems).

- Easy interconnection amongst different system (e.g. GPS, Internet, other communication networks).

Dangers Associated with 4G

The dangers that may be associated with 4G cannot be ignored. They include:

- **Tracking:** GPS devices and mobile navigation systems can determine our locations quite precisely and allow others to easily track us down.

- **Complex Mobile devices:** New layers of technological abstraction will be added, lower layers may be fairly secure, and software at higher layers may introduce vulnerabilities or vice-versa.

- **Attacks on application level:** 4G cellular wireless devices will be known for software applications which will provide innovative features to the user. However, they will also introduce new holes, leading to more attacks at the application level. Attacks with blended treats could be more devastating.

- **Jamming and spoofing:** Jamming happens when a transmitter sending out signals at the same frequency displaces a GPS signal. Spoofing refers to fake GPS signals being sent out, in which case the GPS receiver thinks that the signals comes from a satellite and calculates the wrong co-ordinates. Criminals can use such techniques to interfere with law enforcement agency work.

- **Location Based Services (LBS):** Law Enforcement Agencies with the help of GPS receiver can quickly determined which unit is closest to the location of a reported incident and can get there fast. Alternatively

criminals can deceive the Law Enforcement Agencies by using such smart methods.

- **Encryption:** If a GPS receiver has to communicate with the central transmitter then the communication link between these two components is not hard to break and there is a need for using encrypted data.

- **WiFi, Hotspots and WLANs:** 4G technology will lead to the development of mobile devices with multiple applications and the misuse will increase, particularly when those devices communicate with WiFi, Hotspots and WLANs. Data transmitted over such networks can often be intercepted quite easily, resulting in real security risk.

It is to be observed that all these dangers are more or less problems that must be tackled by IT professionals. This implies that as 4G technology evolves, more job opportunities emerge for upcoming professionals.

POSSIBLE REAL SCENERIOS

A person may have a computer, a handset a tab or a combination of the three. A handset comprises a computer with at least 1 Gigabyte (Gb) of main memory and at least 10 terabytes of detachable secondary memory, a transceiver (transmitter/receiver), intelligent software (expert systems), sensors for acquisition of data and information,. The handset will contain all data and information that you wish to have including personal information about you such as your name, age/home address, phone number, occupation, plane of work, blood group, health history, family history, retirement status, etc. Confidential information can only be obtained with your permission which can only be activated with your personal

ID which could be a combination of your tomb print and retina of your eye (Asagba and Nwachukwu 2005).
You are completely in control of your system.
In addition your computer/handset seamlessly forms local area networks (LANS) with other handsets within your immediate u-space. With both GSM and GPS facilities your location is precisely identifiable.

If you are in a LAN made up of nearest neighbours and those other neighbours are also in other LANS and so on, you discover that you are actually in a global network if any of the computers/handsets is connected to the internet. Thus your single computer/handset is effectively made up of many computers (one person many computers) - Ubiquitous computing!

The above scenario will apply to a tab. The main difference between a handset and a tab is that the tab may not have the processing capability of a computer system, It may not also be used as a phone. It may have embedded microprocessors, storage facility, sensors, and transceivers and can be wirelessly connected to a computer, or device within its u-space.

Since a tab can be used for both people and things, their prices could be very low due to resultant mass production. The implication of all these is that items in your home at a shop, school, supermarket, factory, business houses, offices etc, can be tagged and monitored any time, anywhere and any place.

Items that can be seamless connected to ubiquitous computer systems include ubiquitous robots. A combination of the two is the epitome of ubiquitous computing.

An Illustrative Example

You go to see a Doctor and standing at the door is a well dressed robot with all the attributes of a gentleman. The sensor on the robot reads the data on your tab/handset. It checks the hospital database and discovers that you are not registered with them and politely directs you to the reception for registration.

At the reception is a lady (robot) that has gotten all your particulars from your tab/handset and asks you to pay to the cashier who is nothing but an intelligent machine that has the sensors that can detect valid naira notes and their denominations.

The cashier (robot) then directs you to the consulting room where you meet a nurse (robot) who checks your temperature and blood pressure before directing you to a doctor (humanoid robot) which incorporates an expert system, the Mycin. The “doctor” already knows your names and other details including your temperature and blood pressure, which are all in the hospital database. Based on all these information the “doctor” politely asks questions that lead to the diagnosis of a sickness and the prescription of drugs. It then directs you to the pharmacy where an attendant (robot) tells you your bill and collects the money before dispensing you with the drugs.

If an injection is needed, you are directed to another nurse (robot) that will do the job.

If the ‘doctor’ deems it necessary you may be referred to a Specialist who may be another robot or a human being who himself may be aided by an expert system.

All the transactions in this hospital are securely retained in a database which can be utilized by human doctors and researchers for improvement of all aspects of health delivery. This example can be replicated in almost every human activity.

UNIQUE UNIPORT UBIQUITOUS VIRTUAL CLASSROOM CONCEPT (U^3VC^2)

Here at the University of Port Harcourt we are looking at a Unique Uniport ubiquitous Virtual Classroom Concept (U^3VC^2). This concept takes any location within the three University Parks (Delta Choba, and "Abuja") as a classroom within the Uniport ubiquitous space (uu – space). A classroom in this context may be a computer lab, a small lecture room, a big lecture hall, a student hostel or a lecturer's office space.

The main components will among other things include wireless intranet, PC's and laptops with wireless capabilities, sensors, transducers, transceivers, hardware and software interfaces, servers with mirror-images and expert systems.

We intend in the first instance to develop a computer-based learning and resources management system which should incorporate the following features;

- Wide-screen index for quick and easy access to subject topics
- Navigation controls
- Lesson tests and exam practice questions with detailed feed-back mechanism

- Virtual blackboard for illustrations and
- Simulated screens.

We visualize a situation where students can take lectures, do assignments, take exams, and get real-time result anywhere, any time, any place within u^3vc^2. Other capabilities of ubiquitous computing will later be incorporated.

We have already developed and tested a pilot wireless virtual computer lab using existing technology. A switch, wireless router, and outdoor access points have been installed and configured in the lab for access within the faculty of Science. Necessary application programmes and security systems are currently being developed.

The long term aim is to expand this project, as technology and resources become available, into a functional Unique Uniport Ubiquitous Computer system.

CONCLUDING REMARKS

We are at a stage in history where Information Technology cannot be ignored. If properly harnessed IT could and should create wealth, improve our quality of life, improve communication, reduce the number of working hours, enable the majority of us to work from the comforts of our homes; thereby reducing the demand for transportation, office space and furniture, and saving costs on electricity, air conditioners, wear and tear.

Meetings would be organized using video-conferencing, which will save costs of snacks, transportation, hotel accommodation, loss of man-hours in traveling time, and

reduction in risks of traveling. Physical meetings would be more for pleasure than for work.

With the exception of very minor expenses like paying for groundnuts, bananas and roasted maize, all other payments will be e-payment. This will lead to less cash (cashless) society. Payment for ransoms will be e-payment since you may not be able to withdraw more than say ten thousand Naira cash per week or per month. If you lodge more than say twenty thousand Naira cash into your bank account, a computer will raise an alarm and a robot may arrest and interrogate you. In order to achieve all these, investment in IT infrastructure will have to dramatically increase at the expense of physical infrastructure.

We should note however that a lot of research is going on in humanoid robotics which will produce robots that can recreate and reproduce themselves without any human intervention. If you add to this the capabilities of Expert systems, (which are programs that are capable of solving problems that are difficult enough to require an expert in that field), then we may have a situation where machines (robots) will determine the fate of humanity.

If we now consider the implications of ubiquitous computing, we realize that each and every one of us who has a handset or a tag can be monitored, tracked and traced anywhere, anytime and anyplace. All data and information about you can be acquired stored and used without your knowledge.

The social, religious, economic and political implications of all these could lead to the extermination or enslavement of the majority of us. It only needs a few tyrants in a handful of

countries to realize this unwelcome dream that has a finite possibility.

The implication of all these is that everybody has to be interested in Information Technology; be you in academics, in administration, an engineer, a politician, a researcher, a religious leader, a member of the armed forces, a legal practitioner or an ordinary citizen. The next world war will be fought, lost and won with Information Technology.

Students and the rest of the younger generation cannot afford to ignore Information Technology because IT is power.

Mr. Vice-chancellor Sir,

Information Technology can be an albatross of a bird with very wide wing span and efficient feeding techniques that can improve the well being of humanity, if we embrace and properly apply it. If however, we ignore it, Information Technology may become the albatross of a metaphor.

Thank you and God bless.

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