Seminar on ubiquitous computing essay

UBIQUITIOUS COMPUTING Varun. R USN- 1RE08EC110 Reva Institute of Technology and Management Bangalore. com Abstract-

The highest ideal of ubicomp is to make a computer so imbedded, so fitting, so natural, that we use it without even thinking about it. One of the goals of ubiquitous computing is to enable devices to sense changes in their environment and to automatically adapt and act based on these changes, based on user needs and preferences.

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. Keywords— ubicomp, nanotechnology
Introduction Ubiquitous computing (often abbreviated to " ubicomp") refers to a new genre of computing in which the computer completely permeates the life of the user. In ubiquitous computing, computers become a helpful but invisible force, assisting the user in meeting his or her needs without getting in the way.

Mark Weiser, the originator of the term " ubiquitous computing", " described it this way: "… [Ubiquitous computing's] highest ideal is to make a computer so imbedded, so fitting, so natural, that we use it without even thinking about it. " It is also referred to as Pervasive computing. Pervasive computing environments involve the interaction, coordination, and cooperation of numerous, casually accessible, and often invisible computing devices. These devices will connect via wired and wireless links to one another as well as to the global networking infrastructure to provide more relevant information and integrated services.

Existing approaches to building distributed applications, including client/server computing, are ill suited to meet this challenge. They are targeted at smaller and less dynamic computing environments and lack sufficient facilities to manage changes in the network configurations. Networked computing devices will proliferate in the user's landscape, being embedded in objects ranging from home appliances to clothing. Applications will have greater awareness of context, and thus will be able to provide more intelligent services that reduce the burden on users to direct and interact with applications.

Many applications will resemble agents that carry out tasks on behalf of users by exploiting the rich sets of services available within computing environments. Our preliminary approach is to activate the world and provide hundreds of wireless computing devices per person per office, of all scales. This has required network in operating systems, user interfaces, networks, wireless, displays, and many other areas. We call our work as " ubiquitous computing". This is different from PDA's, dynabooks, or information at your fingertips.

It is invisible; everywhere computing that does not live on a personal device of any sort, but is in the woodwork everywhere. Nanotechnology and Wireless Technology If computers are to be everywhere, unobtrusive, and truly helpful, they must be as small as possible and capable of communicating between themselves. Technological movements supporting these goals are already well underway under the rubrics nanotechnology and wireless computing. Nanotechnology The trend toward miniaturization of computer components down to an atomic scale is known as nanotechnology.

Nanotechnology involves building highly miniaturized computers from individual atoms or molecules acting as transistors, which are the heart of the computer chip. The number of transistors in a chip is indicative of its power. Therefore, nanotechnology's extreme miniaturization of transistors allows for impressive levels of computing power to be put into tiny packages, which can then be unobtrusively tucked away. Wireless Computing Wireless computing refers to the use of wireless technology to connect computers to a network.

Wireless computing is so attractive because it allows workers to escape the tether of a network cable and access network and communication services from anywhere within reach of a wireless network. Wireless computing has attracted enormous market interest, as witnessed by consumer demand for wireless home networks, which can be purchased for several hundred dollars. Context-Awareness and Natural Interaction Small computers that communicate wirelessly provide a necessary infrastructure for ubiquitous computing. However, infrastructure is only half of the battle.

As noted above, the ubiquitous computing movement aims to make computers more helpful and easier to use. Indeed, computers should be able to accurately anticipate the user's needs and accommodate his or her natural communication modes and styles. These themes are captured with-in the ubiquitous computing movement's focus on context-aware computing and natural interaction. Context-Awareness The promise of context-awareness is that computers will be able to understand enough of a user's current situation to offer services, resources, or information relevant to the particular context.

The attributes of context to a particular situation vary widely, and may include the user's location, current role (mother, daughter, office manager, soccer coach, etc.), past activity, and affective state. Beyond the user, context may include the current date and time, and other objects and people in the environment. The application of context may include any combination of these elements. For example, a context-aware map might use the information that the user is away from home, has no appointments, and that the time is 6: 00 in the evening to determine that the user could soon be interested in dinner.

It would then prepare to offer the user guidance to nearby restaurants should he or she makes such a request. Natural Interaction Currently, using the computer is part of the task we are attempting to accomplish—something else to focus on, learn, or do in order to accomplish a goal. The idea behind natural interaction is for the computer to supply services, resources, or information to a user without the user having to think about the rules of how to use the computer to get them. In this way, the user is not preoccupied with the dual tasks of using the computer and getting the services, resources, or information.

Donald Norman, a well-known researcher in human–computer interaction, once said that he doesn't want a word processor; he wants a letter writer—something that will allow him to get the job done of writing a letter, without the instrument getting in the way. UbiquiTrain The UbiquiTrain system is based on a database of training content to which users connect via desktop computers and wireless handheld systems. UbiquiTrain loads training

content according to an algorithm that includes a number of context-related cues. The first cue centers on the user's schedule.

For example, if there is an upcoming meeting called by the user, UbiquiTrain would load training content on how to lead meetings. As the meeting time approaches, this training content floats to the top of the list of topics available. A second cue invokes the context of the user's current activities. If the user is working on a task related to an item on his or her to-do list, UbiquiTrain would load corresponding content, as well. For example, the user working on a proposal would cue UbiquiTrain to call up training content on written communication in general and proposal writing in particular.

UbiquiTrain holds content at the ready should users ask for it. The system does not demand the user's attention. As befits the nature of ubiquitous computing, users interact with UbiquiTrain in the way that feels most natural to them. Some users talk to the system, asking it to show them a particular piece of training content. Others, not yet comfortable with talking to a computer, use the touch screen. UbiquiTrain reacts to the user, as well. Noting the confusion on the user's face as it explains how to deal with attendees who derail meetings, for example UbiquiTrain tries explaining the concept a different way.

It then offers a short video example. Observing that the user is nodding, UbiquiTrain resumes the normal course of training. Of course, if users are looking for information on a particular topic, they can skip straight to the content simply by asking for it. UbiquiTrain is flexible enough to understand the different ways users might request a given piece of content. UbiquiTrain

is more than a means to deliver already-developed training content. The system also offers important benefits in training needs assessment by monitoring trends in training content demands across users.

The system takes action when it senses a trend in demand for certain broad areas of training content among members of particular departments or among workers with similar duties across different departments. As a means of respecting user's privacy, the system polls them and asks if they would like to request in-depth training on the topic, taking suggestions for areas in which users might want particular detail. If sufficient interest is found, the results are then forwarded to the group responsible for training in the organization. By observing trends in content demand, UbiquiTrain can also sense when its database is incomplete.

If users ask for content that doesn't exist in the database, the request is logged. If a sufficient number of similar requests are received, the system generates a requisition for new content. In this way, the database stays current with the needs of its users. Finally, UbiquiTrain can help evaluate the training it has delivered. The most overt way is to ask the user for feedback on the training received. A second way is have the user request relevant coworkers to evaluate him or her in a given area at a given time, if appropriate. The rating task, of course, is administered by UbiquiTrain through the coworkers' computers or handhelds.

Raters can choose to make their ratings and comments anonymous, if they wish. Once all of the data are compiled, UbiquiTrain feeds them back to the user and offers appropriate development suggestions. The system makes

use of the data, as well, to track the effectiveness of the training it has delivered. Clearly, UbiquiTrain offers important benefits to all constituents. Users have a convenient, up-to-date training tool that unobtrusively responds to their needs. At the corporate level, the training needs within the organization are easily tracked and clearly delineated and can be analyzed to fine detail. Current Embedded Technology

Embedded technology is the process of introducing computing power to various appliances. These devices are intended to perform certain specific jobs and processors giving the computing power are designed in an application oriented way. Computers are hidden in numerous information appliances which we use in our day to- day life. These devices find there application in every segment of life such as consumer electronics, avionics, biomedical engineering, manufacturing, process control, industrial, communication, defence etc… Embedded systems, based on there functionality and performance requirement are basically categorized as: i.

Stand alone systems ii. Real time systems iii. Networked systems iv. Mobile devices Stand alone systems work in stand alone mode, taking inputs and producing desired outputs. They do not have any dependence on other systems. Embedded systems in which some specific work has to be done in a specific time period are called Real time systems. Meeting the dead line is the most important requirement of a real time system. In Hard real time systems, missing a deadline may lead to a atastrophe and in Soft real time systems such problem is not present.

Systems which are provided with network interfaces and accessed by networks such as LAN or the Internet are called Networked Systems. Networking may be wired or wireless. Mobile devices are devices which move from one location to another, like mobile phones, PDA'S etc. Today, many people carry numerous portable devices, such as laptops, mobile phones, PDAs and mp3 players, for use in their professional and private lives. For the most part, these devices are used separately i. e. , their applications do not interact.

However, if they could interact directly, participants at a meeting could share documents or presentations, business cards would automatically find their way into the address register on a laptop and the number register on a mobile phone, as commuters exit a train, their laptops could remain online; likewise, incoming email could now be diverted to their PDAs. In such a distributed environment where several embedded devices has to communicate and co-ordinate with each other. For this a communication link is required which may be wired or wireless.

In initial stages of Networked embedded system environments wired connection was preferred as it provided a safer and faster channel for communication. But the cost, immovability and the cables running around the floorboards became less attractive. On top of this, dishing out the cash for network cards, cables and a hub/switch reserved this practice to the more elite computer users, until wireless networking hit the scene. Infrared communication was initially used for wireless communication because of the low cost offered by it. But it suffered from the limitation that it can be used only within Line Of Sight. IEEE introduced 802. 1 as the international

standard for wireless LANs. This used a 2. 4GHz transmission band while maintaining a steady 1-2 Mbps bandwidth rate. Being that this was extremely slow compared to 100Mbit wired LANs, it took a while for the 802. 11 standard to develop into a viable solution, achieved shortly after with the 802. 11a, b and g standards, offering bandwidth ranging from 11Mbps to 54Mbps. Although this is still considerably short of the 100Mbit found in cabled networks, 802. 1 x wireless technologies is now literally regarded as the future of networking. Bluetooth, Wi-Fi, Wi-Max are the latest solutions, under the 802. x standard, for wireless communication over short, medium and long range communication respectively. Pervasive Computing Earlier in this paper, we characterized a pervasive computing environment as one saturated with computing and communication capability, yet so gracefully integrated with users that it becomes a '' technology that disappears. '' Since motion is an integral part of everyday life, such a technology must support mobility; otherwise, a user will be acutely aware of the technology by its absence when he moves. Hence, the research agenda of pervasive computing subsumes that of mobile computing, but goes much further.

Specifically, pervasive computing incorporates four additional research thrusts into its agenda, as illustrated by Figure 1. Effective Use of Smart Spaces The first research thrust is the effective use of smart spaces. A space may be an enclosed area such as a meeting room or corridor, or it may be a well-defined open area such as a courtyard or a quadrangle. By embedding computing infrastructure in building infrastructure, a smart space brings together two worlds that have been disjoint until now [16]. The fusion of these worlds enables sensing and control of one world by the other.

A simple example of this is the automatic adjustment of heating, cooling and lighting levels in a room based on an occupant's electronic profile. Influence in the other direction is also possible — software on a user's computer may behave differently depending on where the user is currently located. Smartness may also extend to individual objects, whether located in a smart space or not. Invisibility The second thrust is invisibility. The ideal expressed by Weiser is complete disappearance of pervasive computing technology from a user's consciousness. In practice, a reasonable approximation to this ideal is minimal user distraction.

If a pervasive computing environment continuously meets user expectations and rarely presents him with surprises, it allows him to interact almost at a subconscious level [46]. At the same time, a modicum of anticipation may be essential to avoiding a large unpleasant surprise later — much as pain alerts a person to a potentially serious future problem in a normally-unnoticed body part. Localized Scalability The third research thrust is localized scalability. As smart spaces grow in sophistication, the intensity of interactions between a user's personal computing space and his surroundings increases.

This has severe bandwidth, energy and distraction implications for a wireless mobile user. The presence of multiple users will further complicate this problem. Scalability, in the broadest sense, is thus a critical problem in pervasive computing. Previous work on scalability has typically ignored physical distance — a web server or file server should handle as many clients as possible, regardless of whether they are located next door or across the country. The situation is very different in pervasive computing.

Here, the density of interactions has to fall off as one moves away — otherwise both the user and his computing system will be overwhelmed by distant interactions that are of little relevance. Although a mobile user far from home will still generate some distant interactions with sites relevant to him, the preponderance of his interactions will be local. Like the inverse square laws of nature, good system design has to achieve scalability by severely reducing interactions between distant entities. This directly contradicts the current ethos of the Internet, which many believe heralds the '' death of distance. ''

Masking Uneven Conditioning The fourth thrust is the development of techniques for masking uneven conditioning of environments. The rate of penetration of pervasive computing technology into the infrastructure will vary considerably depending on many non-technical factors such as organizational structure, economics and business models. Uniform penetration, if it is ever achieved, is many years or decades away. In the interim, there will persist huge differences in the '' smartness'' of different environments — what is available in a well-equipped conference room, office, or classroom may be more sophisticated than in other locations.

This large dynamic range of '' smartness'' can be jarring to a user, detracting from the goal of making pervasive computing technology invisible. One way to reduce the amount of variation seen by a user is to have his personal computing space compensate for '' dumb'' environments. As a trivial example, a system that is capable of disconnected operation is able to mask the absence of wireless coverage in its environment. Complete invisibility may be impossible, but reduced variability is well within our reach. [pic]

This figure shows how research problems in pervasive computing relate to those in mobile computing and distributed systems. New problems are encountered as one move from left to right in this figure. In addition, the solution of many previously-encountered problems becomes more complex. As the modulation symbols suggest, this increase in complexity is multiplicative rather than additive — it is very much more difficult to design and implement a pervasive computing system than a simple distributed system of comparable robustness and maturity. Note that this figure describes logical relationships, not temporal ones.

Although the evolution of research effort over time has loosely followed this picture, there have been cases where research effort on some aspect of pervasive computing began relatively early. For example, work on smart spaces began in the early 1990's and proceeded relatively independently of work in mobile computing. Figure 1: Taxonomy of Computer Systems Research Problems in Pervasive Computing Example Scenarios What would it be like to live in a world with pervasive computing? To help convey the '' look and feel'' of such a world, we sketch two hypothetical scenarios below.

We have deliberately chosen scenarios that appear feasible in just a few years. These examples use Aura as the pervasive computing system, but the concepts illustrated are of broad relevance. Scenario 1 Jane is at Gate 23 in the Pittsburgh airport, waiting for her connecting flight. She has edited many large documents, and would like to use her wireless connection to e-mail them. Unfortunately, bandwidth is miserable because many passengers at Gates 22 and 23 are surfing the web. Aura observes that at the current

bandwidth Jane won't be able tofinish sending her documents before her flight departs.

Consulting the airport's network weather service and flight schedule service, Aura discovers that wireless bandwidth is excellent at Gate 15, and that there are no departing or arriving flights at nearby gates for half an hour. A dialog box pops up on Jane's screen suggesting that she go to Gate 15, which is only three minutes away. It also asks her to prioritize her e-mail, so that the most critical messages are transmitted first. Jane accepts Aura's advice and walks to Gate 15. She watches CNN on the TV there until Aura informs her that it is close to being done with her messages, and that she can start walking back.

The last message is transmitted during her walk, and she is back at Gate 23 in time for her boarding call. Scenario 2 Fred is in his office, frantically preparing for a meeting at which he will give a presentation and a software demonstration. The meeting room is a ten-minute walk across campus. It is time to leave, but Fred is not quite ready. He grabs his PalmXXII wireless handheld computer and walks out of the door. Aura transfers the state of his work from his desktop to his handheld, and allows him to make his final edits using voice commands during his walk. Aura infers where Fred is going from his calendar and the campus location racking service. It downloads the presentation and the demonstration software to the projection computer, and warms up the projector. Fred finishes his edits just before he enters the meeting room. As he walks in, Aura transfers his final changes to the projection computer. As the presentation proceeds, Fred is about to display a slide with highly sensitive budget information. Aura senses that this might be

a mistake: the room's face detection and recognition capability indicates that there are some unfamiliar faces present. It therefore warns Fred. Realizing that Aura is right, Fred skips the slide.

He moves on to other topics and ends on a high note, leaving the audience impressed by his polished presentation. Missing Capabilities These scenarios embody many key ideas in pervasive computing. Scenario 1 shows the importance of pro activity: Jane is able to complete her e-mail transmission only because Aura had the foresight to estimate how long the whole process would take. She is able to begin walking back to her departure gate before transmission completes because Aura looks ahead on her behalf. The scenario also shows the importance of combining knowledge from different layers of the system.

Wireless congestion is a low-level system phenomenon; knowledge of boarding time is an application or user-level concept. Only by combining these disparate pieces of knowledge can Aura help Jane. The scenario also shows the value of a smart space. Aura is able to obtain knowledge of wireless conditions at other gates, flight arrival/departure times and gates, and distance between gates only because the environment provides these services. Scenario 2 illustrates the ability to move execution state effortlessly across diverse platforms — from a desktop to a handheld machine, and from the handheld to the projection computer.

Self-tuning, or automatically adjusting behavior to fit circumstances, is shown by the ability to edit on the handheld using speech input rather than keyboard and mouse. The scenario embodies many instances of pro activity:

inferring that Fred is headed for the room across campus, warming up the projector, transferring the presentation and demonstration, anticipating that the budget slide might be displayed next, and sensing danger by combining this knowledge with the inferred presence of strangers in the oom. The value of smart spaces is shown in many ways: the location tracking and online calendar services are what enable Aura to infer where Fred is heading; the software-controlled projector enables warm up ahead of time; the camera-equipped room with continuous face recognition is key to warning Fred about the privacy violation he is about to commit. Perhaps the biggest surprise in these scenarios is how simple and basic all the component technologies are.

The hardware technologies (laptops, handhelds, wireless communication, software-controlled appliances, room cameras, and so on) are all here today. The component software technologies have also been demonstrated: location tracking, face recognition, speech recognition, online calendars, and so on. Why then do these scenarios seem like science fiction rather than reality today? The answer lies in the fact that the whole is much greater than the sum of its parts. In other words, the real research is in the seamless integration of component technologies into a system like Aura.

The difficult problems lie in architecture, component synthesis and system-level engineering. Difference between traditional networking and pervasive computing These connections are fundamentally unlike those we associate with networks. Rather than using the network to connect computers that are being used directly by people, these appliances communicate over networks such that people do not directly monitor the communication between machines and programs.

The majority of these communications will occur in an end-to-end structure that does not include a human at any point. The number of machines connected to the Internet has been increasing at an exponential rate and will continue to grow at this rate as the existing networks of embedded computers, including those that already exist within our automobiles, are connected to the larger, global network, and as new networks of embedded devices are constructed in our homes and offices.

The kinds of devices that will be used to access the Internet are no longer confined to desktops and servers, but include small devices with limited user interface facilities (such as cell phones and PDAs); wireless devices with limited bandwidth, computing power, and electrical power; and embedded processors with severe limitations on the amount of memory and computing power available to them. Many of these devices are mobile, changing not only geographic position, but also their place in the topology of the network. Unlike traditional Desktop Computers and existing networks, the new devices will have the following characteristics: 1.

Many will have small, inexpensive processors with limited memory and little or no persistent storage. 2. They will connect to other computing elements without the direct intervention of users. 3. Often, they will be connected by wireless networks. 4. They will change rapidly, sometimes by being mobile, sometimes by going on and offline at widely varying rates. Over time, they will be replaced (or fail) far more rapidly than is now common. 5. They will be used as a source of information, often sending that information into the center of the network to which they are attached.

Ubi-Finger Here, in contrast, Ubi-Finger is the gesture-i/p device, which is simple, compact and optimized for mobile use. Using our systems, a user can detect a target device by pointing with his/her index finger, and then control it flexibly by performing natural gestures of fingers (Fig. 1). [pic][pic][pic] | | | | | By pointing a light and making| | The light will turn on! | | a gesture like " push a | | | | switch". | | | Figure- 1 An example to control Home Appliances | [pic] Figure- 2 As shown in fig. 2, ubi-finger consists of three sensors to detect gestures of fingers, an infrared transmitter to select a target device in real world and a microcomputer to control these sensors and communicate with a host computer. each sensor generates the information of motions as follows: (1) a bending degree of the index finger, (2) tilt angles of the wrist, (3) operations of touch sensors by a thumb.

We use (1) and (2) for recognition of gestures, and use (3) for the trigger mechanism to start and stop gesture recognitition. Information Hoppers and Smart Posters Once these zones are setup, computers on the network will have some interesting capabilities. The system will help to store and retrieve data in an Information hopper. This is a timeline of information that keeps track of when data is created. The hopper knows who created it, where they were and who they were with. Another application that will come out of this ultrasonic location system is the smart poster.

A convention computer interface requires us to click on a button on your computer screen. In this new system, a button can be placed anywhere in your workplace, not just on the computer display. The idea behind smart posters is that a button can be a piece of paper that is printed out and struck on a wall. Smart posters will be used to control any device that is plugged

into the network. The poster will know where to send a file and a user's preferences. Smart posters could also be used in advertising new services.

To press a button on a smart poster, a user will simply place his or her bat in the smart poster button and click the bat. The system automatically knows who is pressing the poster's button. Posters can be created with several buttons on it. Ultrasonic location systems will require us to think outside of the box. Traditionally, we have used our files, and we may back up these files on a network server. This ubiquitous network will enable all computers in a building to transfer ownership and store all our files in a central timeline. HAVi- An Implementation in Consumer Appliance Environment

HAVi is a standard for home appliances consisting of a set of APIs, services, and a standard for communication. HAVi's primary goal is providing a dynamic service environment in which software components can discover and interact with other. It provides mechanisms for devices to discover, query and control other appliances on the home network, and provides system services such as message and event. Eight major consumer electronics manufacturers have come up with an open standard enabling home entertainment devices to communicate intelligently with each other.

The HAVi(Home Audio Video Interoperability) standard promises to bring true platform independent interoperability to consumer devices using high bandwidth IEEE 1394 (FireWire) as the connecting medium. Major consumer electronics, software, semiconductor and computer manufacturers, namely Grundig, Hitachi, Panasonic, Philips, Sharp, Sony, Thomson and Toshiba along with now over 30 other participants, have formed a non-profit

organization called HAVi (Home Audio Video Interoperability) for promoting the development of interoperable consumer products.

The goal of HAVi organization is to provide a standard open architecture for intelligent audio and video devices to interoperate with each other regardless of manufacturer, operating system, CPU or programming language used for implementation. The simplest example can be time synchronization between different devices. TV set might get the correct time from the broadcast stream and the other devices can query the TV and set their own clocks according to it. Setting the VCR to record a program is a familiar situation users usually have problems with.

With HAVi enabled devices this task can be made very easy. User can select the program he wishes to record with the Electronic Program Guide (EPG) residing on a digital TV set (or set top- box). The TV then locates an available recorder (e. g. , a VCR or a recording DVD device) and commands it to record the program supplying it with the time, length and channel parameters taken from the EPG. Thus, the user doesn't need to program or touch the recording device in any way. The advantages of Pervasive Computing:

We increasingly rely on the electronic creation, storage, and transmittal of personal, financial, and other confidential information, and demand the highest security for all these transactions and require complete access to time-sensitive data, regardless of physical location. We expect devices — personal digital assistants, mobile phones, office PCs and home entertainment systems — to access that information and work together in

one seamless, integrated system. Pervasive computing gives us the tools to manage information quickly, efficiently, and effortlessly.

It aims to enable people to accomplish an increasing number of personal and professional transactions using a new class of intelligent and portable appliances or " smart devices" embedded with microprocessors that allow users to plug into intelligent networks and gain direct, simple, and secure access to both relevant information and services.. It gives people convenient access to relevant information stored on powerful networks, allowing them to easily take action anywhere, anytime.

Pervasive computing simplifies life by combining open standards-based applications with everyday activities. It removes the complexity of new technologies, enables us to be more efficient in our work and leaves us more leisure time and thus pervasive computing is fast becoming a part of everyday life. Concerns The power ubiquitous computing promises carries with it significant risks. One such risk is associated with the amount of privacy that must be sacrificed to see the benefits of truly helpful computers.

Another is that early, " bleeding edge" applications of ubiquitous computing will turn out to be more ambitious than effective, leading some to prematurely conclude that the idea is a failure. We address each of these concerns below. Privacy Issues Simply put the more software tracks users, the more opportunities exist to trample on their right to privacy. To some degree, these issues are already being argued in the contexts of corporate e-mail snooping and the use of IT software that can track user activity down to the level of individual keystrokes.

However, factoring in the idea of software that can track and act upon a user's physical presence and form of activity leads to privacy concerns of a magnitude beyond those currently debated. The privacy implications of ubiquitous computing implementations must always be accorded the most careful consideration. Without powerful standards surrounding user privacy, the future world of ubiquitous computing may very well shift from one of ease and convenience to one where each of us has an inescapable sense of being watched, at best, and no control over our personal information, at worst.

Such prospects are clearly far from desirable. Growing Pains Systems that can act as subtly as those described will not come without a substantial developer learning curve. As system developers learn from their mistakes, there will undoubtedly be at least one premature declaration that truly ubiquitous computing is an impractical ideal and that the interim efforts are too riddled with problems to be usable. We cannot guarantee that ubiquitous computing will fulfill its promise. However, we would argue that it ought to do so, based on the strong trend we have observed toward more powerful, more usable software.

The first author recalls a word processor from about 1984 that required the manual entry of printer codes for boldface and italic fonts. Advanced ideas like templates and styles—and, come to think of it, tables—were far from consideration as features. Modern word processors are very powerful, flexible, and easy to use compared to anything that has come before. Usability is definitely a recognized goal in software design, and much has

been learned to make new software—even unique, new applications—very easy to use.

It should only get better. Ongoing Research: A number of leading technological organizations are exploring pervasive computing. Xerox's Palo Alto Research Center (PARC), for example, has been working on pervasive computing applications since the 1980s. Although new technologies are emerging, the most crucial objective is not, necessarily, to develop new technologies. IBM's project Planet Blue, for example, is largely focused on finding ways to integrate existing technologies with a wireless infrastructure.

Carnegie Mellon University's Human Computer Interaction Institute (HCII) is working on similar research in their Project Aura, whose stated goal is " to provide each user with an invisible halo of computing and information services that persists regardless of location. " The Massachusetts Institute of Technology (MIT) has a project called Oxygen. MIT named their project after that substance because they envision a future of ubiquitous computing devices as freely available and easily accessible as oxygen is today.

What is this next generation going to look like? Today the uses of Internet are limited as its users look for read-mostly information. As we move to a world where the Internet is used as an infrastructure for embedded computing, all this will change. We can hypothesize that the individual utility of mobile communication, wireless appliances and the respective mobile services – pervasive technologies in general – will be exploited through a digital environment that is – • aware of their presence sensitive, adaptive and responsive to their needs, habits and emotions • and ubiquitously

accessible via natural interaction. Increasingly, many of the chips around us will sense their environment in rudimentary but effective ways. For Example – ? Cell phones will ask the landline phone what its telephone number is and will forward our calls to it. ? Remote computers will monitor our health statistics and will determine when one is in trouble and will take appropriate action for rescue. Amplifiers will be implanted and used in the inner ear. ? New machines that scan, probe, penetrate and enhance our bodies will be used. ? Refrigerators will be connected to the Internet so one could find out, via cell phone or PDA, what is in it while one is at the store. A refrigerator may even sense when it is low on milk and order more directly from the supplier or rather than this, the connection will enable the manufacturer to monitor the appliance directly to ensure that it is working correctly and inform the owner when it is not. Stoves will conspire with the refrigerators to decide what recipe makes the best use of the available ingredients, and then guide us through preparation of the recipe with the aid of a network-connected food processor and blender. Or they will communicate to optimize the energy usage in our households. ? Cars will use the Internet to find an open parking space or the nearest vegetarian restaurant for their owners or to allow the manufacturer to diagnose problems before they happen, and either inform the owner of the needed service or automatically install the necessary (software) repair. Wrist watches will monitor our sugar. [pic] ? Digi-tickers or implanted heart monitors in heart patients will talk wirelssly to computers, which will be trained to keep an eye open for abnormalities. [pic] In a nutshell, our personal network will travel around with us like a surrounding bubble, connecting to the environment through which we move and allowing our mobile tools to provide us with more functionality than they

ever could alone. Conclusion: Pervasive computing provides an attractive vision for the future of computing.

Well, we no longer will be sitting down in front of a PC to get access to information. In this wireless world we will have instant access to the information and services that we will want to access with devices, such as Smartphones, PDAs, set-top boxes, embedded intelligence in your automobile and others, all linked to the network, allowing us to connect anytime, anywhere seamlessly, and very importantly, transparently. Computational power will be available everywhere through mobile and stationary devices that will dynamically connect and coordinate to smoothly help users in accomplishing their tasks.

We are heading toward a reality that plays like a scene from Star Trek. We may have difficulty envisioning these possibilities, but they are not remote anymore. Technology is rapidly finding its way into every aspect of our lives. Whether it's how we shop, how we get from one place to another or how we communicate, technology is clearly woven into the way we live. Indeed, we are hurtling " towards pervasive computing". When Edison finally found a filament that would burn, did he see the possibility of silent but pervasive electrical current flowing throughout our homes, cars and communities?

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All paragraphs must be justified, i. e. both left-justified and right-justified. Text Font of Entire Document The entire document should be in Times New Roman or Times font. Type 3 fonts must not be used. Other font types may be used if needed for special purposes. Recommended font sizes are shown in Table 1. A. Title and Author Details Title must be in 24 pt Regular font. Author name must be in 11 pt Regular font. Author affiliation must be in 10 pt Italic. Email address must be in 9 pt Courier Regular font. Font Sizes for Papers Font | Appearance (in Time New Roman or Times) | | Size | | | | Regular | Bold | Italic | | 8 | table caption (in Small | | reference item | | | Caps), | |(partial) | | | figure caption, | | | | | reference item | | | | 9 | author email address (in | abstract body | abstract heading (also | | | Courier), | | in Bold) | | | cell in a table | | | | 10 | level-1 heading (in Small| | level-2 heading, | | | Caps), | | level-3 heading, | | | paragraph | | author affiliation | | 11 | author name | | | | 24 | title | | | All title and author details must be in single-column format and must be centered. Every word in a title must be capitalized except for short minor words such as “ a”, “ an”, “ and”, “ as”, “ at”, “ by”, “ for”, “ from”, “ if”, “ in”, “ into”, “ on”, “ or”, “ of”, “ the”, “ to”, “ with”. Author details must not show any professional title (e. g. Managing Director), any academic title (e. g. Dr.) or any membership of any professional organization (e. g. Senior Member IEEE).

To avoid confusion, the family name must be written as the last part of each author name (e. g. John A. K. Smith). Each affiliation must include, at the

very least, the name of the company and the name of the country where the author is based (e. g. Causal Productions Pty Ltd, Australia). Email address is compulsory for the corresponding author. B. Section Headings No more than 3 levels of headings should be used. All headings must be in 10pt font. Every word in a heading must be capitalized except for short minor words as listed in Section III-B. Level-1 Heading: A level-1 heading must be in Small Caps, centered and numbered using uppercase Roman numerals. For example, see heading " III.

Page Style" of this document. The two level-1 headings which must not be numbered are " Acknowledgment" and " References". Level-2 Heading: A level-2 heading must be in Italic, left-justified and numbered using an uppercase alphabetic letter followed by a period. For example, see heading " C. Section Headings" above. Level-3 Heading: A level-3 heading must be indented, in Italic and numbered with an Arabic numeral followed by a right parenthesis. The level-3 heading must end with a colon. The body of the level-3 section immediately follows the level-3 heading in the same paragraph. For example, this paragraph begins with a level-3 heading. A.

Figures and Tables Figures and tables must be centered in the column. Large figures and tables may span across both columns. Any table or figure that takes up more than 1 column width must be positioned either at the top or at the bottom of the page. Graphics may be full color. All colors will be retained on the CDROM. Graphics must not use stipple fill patterns because they may not be reproduced properly. Please use only SOLID FILL colors which contrast well both on screen and on a black-and-white hardcopy, as shown in Fig. 1. [pic] Fig. 1 A sample line graph using colors which contrast well both on

screen and on a black-and-white hardcopy Fig. shows an example of a low-resolution image which would not be acceptable, whereas Fig. 3 shows an example of an image with adequate resolution. Check that the resolution is adequate to reveal the important detail in the figure. Please check all figures in your paper both on screen and on a black-and-white hardcopy. When you check your paper on a black-and-white hardcopy, please ensure that: • the colors used in each figure contrast well, • the image used in each figure is clear, • all text labels in each figure are legible. A. Figure Captions Figures must be numbered using Arabic numerals. Figure captions must be in 8 pt Regular font. Captions of a single line (e. g. Fig.) must be centered whereas multi-line captions must be justified (e. g. Fig. 1). Captions with figure numbers must be placed after their associated figures, as shown in Fig. 1. [pic] Fig. 2 Example of an unacceptable low-resolution image [pic] Fig. 3 Example of an image with acceptable resolution B. Table Captions Tables must be numbered using uppercase Roman numerals. Table captions must be centred and in 8 pt Regular font with Small Caps. Every word in a table caption must be capitalized except for short minor words as listed in Section III-B. Captions with table numbers must be placed before their associated tables, as shown in Table 1. B.

Page Numbers, Headers and Footers Page numbers, headers and footers must not be used. C. Links and Bookmarks All hypertext links and section bookmarks will be removed from papers during the processing of papers for publication. If you need to refer to an Internet email address or URL in your paper, you must type out the address or URL fully in Regular font. D. References The heading of the References section must not be numbered. All

reference items must be in 8 pt font. Please use Regular and Italic styles to distinguish different fields as shown in the References section. Number the reference items consecutively in square brackets (e. g. [1]).

When referring to a reference item, please simply use the reference number, as in [2]. Do not use " Ref. [3]" or " Reference [3]" except at the beginning of a sentence, e. g. " Reference [3] shows …". Multiple references are each numbered with separate brackets (e. g. [2], [3], [4]–[6]). Examples of reference items of different categories shown in the References section include: • example of a book in [1] • example of a book in a series in [2] • example of a journal article in [3] • example of a conference paper in [4] • example of a patent in [5] • example of a website in [6] • example of a web page in [7] • example of a databook as a manual in [8] example of a datasheet in [9] • example of a master's thesis in [10] • example of a technical report in [11] • example of a standard in [12] I. Conclusions The version of this template is V2. Most of the formatting instructions in this document have been compiled by Causal Productions from the IEEE LaTeX style files. Causal Productions offers both A4 templates and US Letter templates for LaTeX and Microsoft Word. The LaTeX templates depend on the official IEEEtran. cls and IEEEtran. bst files, whereas the Microsoft Word templates are self-contained. Causal Productions has used its best efforts to ensure that the templates have the same appearance. Acknowledgment

The heading of the Acknowledgment section and the References section must not be numbered. Causal Productions wishes to acknowledge Michael Shell and other contributors for developing and maintaining the IEEE LaTeX style files which have been used in the preparation of this template. To see

the list of contributors, please refer to the top of file IEEETran. cls in the IEEE LaTeX distribution. References 1] S. M. Metev and V. P. Veiko, Laser Assisted Microtechnology, 2nd ed. , R. M. Osgood, Jr. , Ed. Berlin, Germany: Springer-Verlag, 1998. 2] J. Breckling, Ed. , The Analysis of Directional Time Series: Applications to Wind Speed and Direction, ser. Lecture Notes in Statistics. Berlin, Germany: Springer, 1989, vol. 1. 3] S. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, " A novel ultrathin elevated channel low-temperature poly-Si TFT," IEEE Electron Device Lett. , vol. 20, pp. 569–571, Nov. 1999. 4] M. Wegmuller, J. P. von der Weid, P. Oberson, and N. Gisin, " High resolution fiber distributed measurements with coherent OFDR," in Proc. ECOC'00, 2000, paper 11. 3. 4, p. 109. 5] R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, " High-speed digital-to-RF converter," U. S. Patent 5 668 842, Sept. 16, 1997. 6] (2002) The IEEE website. [Online]. Available: http://www. ieee. org/ 7] M. Shell. (2002) IEEEtran homepage on CTAN. [Online]. Available: http://www. ctan. rg/tex-archive/macros/latex/contrib/supported/IEEEtran/ 8] FLEXChip Signal Processor (MC68175/D), Motorola, 1996. 9] " PDCA12-70 data sheet," Opto Speed SA, Mezzovico, Switzerland. 10] A. Karnik, " Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP," M. Eng. thesis, Indian Institute of Science, Bangalore, India, Jan. 1999. 11] J. Padhye, V. Firoiu, and D. Towsley, " A stochastic model of TCP Reno congestion avoidance and control," Univ. of Massachusetts, Amherst, MA, CMPSCI Tech. Rep. 99-02, 1999. 12] Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, IEEE Std. 802. 11, 1997.