• Immovable to Wearable
• Intricacies of Ubiquitous Computing
• Automotive Perspective of Ubiquitous computing
• Early Automotive Failure Detection Using Social Media
• Challenges in Ubiquitous Computing
• Being Ubiquitous : A Boon or Bane
• Future of Ubiquitous Computing
Colophon

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# Contents

**Editorials**  
**Guest Editorial**  
Suresh V.  
**Editorial**  
Dr. Vinay Vaidya  

**Scientist Profile**  
Mark Weiser  
Jyoti Nalawade  

**Book Review**  
Ubiquitous Computing Fundamentals  
Edited by John Krumm  
Shushant Hingane  

**Articles**  
**Immovable to Wearable**  
A Journey from Mainframe to Ubiquitous Computing  
Suyog Wani  

**Intricacies of Ubiquitous Computing**  
Reecha Yadav and Pallavi Kalyanasundaram  

**Automotive Perspective of Ubiquitous computing**  
Ajinkya Gosavi and Amit Patil  

**Early Automotive Failure Detection using Social Media**  
Alan Stacklin and Joe Olson  

**Challenges of Ubiquitous Computing**  
Nitin Nigam  

**Being Ubiquitous: A Boon or Bane**  
Karan Bahl & Venkatesh Kareti  

**Future of Ubiquitous Computing**  
Kaustuv Baral
The term ubiquitous can be defined as 'present everywhere'. Ubiquitous Computing (UbiComp) is also described as Pervasive Computing; ambient intelligence likewise is mostly viewed from human-centric perspective. The computing is made to appear everywhere and anywhere in contrast to that of desktop computing. It promises to give sort of a new perspective or life to the things around. The UbiComp envisages an omnipresence of embedded devices, processors, sensors and other networking technologies.

The ubiquitous computing and other contemporary technologies evolving since late 90s have almost reached their penetrative level encompassing all walks of human life. The newly ushering technologies like 'Internet of Things', 'Machine to Machine', etc. greatly incorporate these evolved concepts. Imagine a world of billions of devices securely interconnected and interacting with each other! This will create a paradigm shift in the way purposeful communication happens between people, computers, physical spaces and devices/things. This is aimed at enhancing quality of life and brings in much desired prosperity and contentment. The proliferation of data or vital information from these 'connected and interacting things' will provide ambient intelligence and, potentially, represent the most path breaking technological revolution. These aim to bring smartness in almost all the spheres of life, like mobility, governance, health care, infrastructure and economy to name a few and, thereby, aim to achieve economy of effort and resources. This in turn conceives what we can term this environment as 'smart' place to live.

Since time immemorial, mankind has always been trying to find ways and solutions to make life easy. The inventions like spoke wheel, sundials and intricate clocks which date back to early periods of known history clearly capture the passion of humans to evolve themselves-intellectually, socially and spiritually. In other words, ever since, mankind strives to transform earth into heaven where there will be no more death or mourning or crying or pain!

Now, the million dollar question is where are we heading? A Jewish scholar said robots will achieve human level intelligence! There are opposite viewpoints that these technological developments will ultimately lead to destruction or robots and computers will take over control of the world. However, an analogous example can be the invention of dynamite or atomic power. An anonymous proverb, 'A sword in the hands of a drunken slave is less dangerous than science in the hands of the unscrupulous, whether man or machine', holds good to these technologies as well.

The “Theory of incongruence” suggests that the expectations cloud the perception. The innovative invention of Quartz technology is the best example that can be cited here. In fact, the Quartz technology was born in the Swiss labs. However, it was quickly discarded by the very same Swiss watch industry whose perception was clouded by unfounded fears that it is unreliable in comparison with the traditional mechanical technology. Whereas, the Seiko watch company of Japan, seeing the enormous potential quartz offers, adopted it quickly to become a household name worldwide. In other words, if the best that a technology can offer is not visualized, one can miss the boat altogether in reaping its benefits.

The aforesaid technologies are targeted towards a safe and sound futuristic world, if used in right manner. The ubiquitous computing includes a range of research topics like wireless sensor networks (WSN), distributed, context-aware, location-aware and mobile computing. The technology circumvents man-machine interface, robotics and artificial intelligence to ultimately impact lives. This can transform world and bring in efficiency, speed and access in governance. As we aspire to bring in UbiComp, we should not lose sight of the possible glaring negative impacts on our existence - environment, climate change and exclusion of have not's from reaping its benefits.

This Ubiquitous Computing - TechTalk issue presents contemporary articles on ubiquitous computing in the applied areas like transportation, health care likewise and captures the challenges faced. This issue will no doubt enlighten the readers to think beyond and contribute towards science/technology for the greater purpose of touching lives.
Ubiquitous or omnipresent computing is a welcome advancement in technology. It is going to take us ahead in the next 50 years into a world that we can hardly imagine today.

In the field of transportation, we are already seeing the effect of computerized solutions to improve safety. It is thanks to the computing advancements that today autonomous vehicles have become a reality. As we go forward, we will continue to collect more data and extract more intelligence thereby increasing comfort, safety, and security while making the ride enjoyable and affordable.

However, we still have major issues in transportation. Our efficiency of energy conversion for an IC engine is between 20 to 30% at best. How to develop smart ECUs to improve the efficiency remains a major challenge.

There is lot more that we can do with energy and computing. Our issues are mainly storage, cost, and clean energy sources. We know how to generate electricity. However, we are still unable to store it at a very large scale. Despite research for over a century, the state of electricity generation is still ‘use it or lose it’. It would be interesting to see how ubiquitous computing can help us get out of this situation. When this issue comes out, there is a workshop planned in Raleigh, North Carolina. It is titled: ‘The First International Workshop on Energy-Aware Ubiquitous Computing’. This clearly shows the interest of the research community in taking forward Ubiquitous computing and applying it to the energy domain.

Researchers across the globe continue to work for betterment of quality of life. Signs of fast advancements in communications technology were very clear with the way the Bell Labs was advancing. Indian’s recent ‘Mars Orbiter Mission’ is a classic example of usage of computers for space exploration. The ability to communicate and control each move of the spacecraft remotely from the earth is certainly a marvel.

The health care industry has made major strides from better imaging through MRI to telemedicine and robotic surgery. There are multiple new technologies, based on computing, that can change the face of health care.

Nano technology will be a major part of our lives in the near future. The nanoscale processes with massive parallelism can make a major impact from a large-scale perspective. The nanomachines can create electronic circuits from one atom at a time. This would lead to the making of nanochips with a very small footprint. Such nanochips would find multiple applications in every discipline.

Research is currently ongoing in reverse engineering the human brain using microchips. This work is likely to be completed by 2030. Once complete, we would be able to develop nonbiological intelligence as an add-on to our brains. By 2020 full nanobot rewiring of the brain would be possible. As per Ray Kurzweil, a prolific inventor and writer, nanobot computers inside our brain will connect us to cloud computing.

Powerful computing and our over dependence was portrayed as a submission to HAL 9000 in the book and the movie 2001 Space Odyssey. The fears from the conversation between Dave and HAL lingered for a while and we always remembered HAL 9000 saying, “I'm sorry Dave, I'm afraid I can't do that”. The development in computing has advanced in a much better manner than once imagined.

We can continue to dream for more things that we can do with computers as they continue to proliferate. By looking at the advancements today, one is reminded of a quote by William Gibson, a well-known science fiction writer, “the future has already arrived—it’s just not evenly distributed.”
Immovable to Wearable – A journey from Mainframe to Ubiquitous Computing

About the Author
Suyog Wani

Areas of Interest
Embedded Computing
I. Introduction

The simplified version of Moore's Law states that processor speeds, or overall processing power for computers will double every two years. He had stated this in 1965 paper. This statement looks valid even in 2014. Due to tremendous processing capabilities with a very small form factor, we have seen the computing scenario changing rapidly.

Ubiquitous Computing or wearable technology is useful for the multiple applications especially related to helping humans. This usually requires advanced computational support more than static logic pre-coded in hardware. Electronic devices involved in this system would spread in certain application area where computing was not imaginable earlier and keep communicating with each other in that environment. These computing devices are well integrated into the things present in the surroundings which are very difficult to notice. They become almost invisible. The aim of ubiquitous computing or UbiComp is to embed a computer system so naturally into the environment that we use it without even thinking about it or noticing it.

In this computing technology, computers are immersed in a real-time environment. Multiple sensors present in the system can interact with each other and control the environment. It requires limited power supply and has limited memory and bandwidth which is enough to carry out its specified task. Generally, these devices are wireless, so they have greater flexibility and portability. Another interesting thing about ubiquitous computing devices is that they can be worn by human beings or can be integrated in wearable clothing and accessories so that the devices can function continuously, without stopping, in an always ON mode!

UbiComp is very different from virtual reality. In fact, it is exactly opposite of virtual reality as far as its goal is concerned. Virtual reality puts humans in a virtual, computerized surroundings whereas goal of UbiComp is to integrate computers into the human world and force the computers to live in the real world along with human beings!

II. History of Ubiquitous Computing

Ubiquitous Computing also called 'UbiComp', was first defined by Dr. Mark Weiser in 1988 in the Electronics and Imaging Laboratory (EIL) of the Xerox Palo Alto Research Center (PARC) [1]. However, it is truly getting deployed only recently, as of now technology has provided desired level of miniaturization and integration of various sensors and electronic computing devices to make the realization possible. An article written by Weiser in Scientific American 1991, contains his famous quote: “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.”

The period during 1940 to 1956 was of first generation computers when concept of computers was getting evolved. These vacuum tube and magnetic drum based memory equipment were of wall size and occupying almost an entire room to accommodate (Figure 2). In Late 1960s, when transistor replaced vacuum tubes, size of computers started reducing and we had second generation of mainframe computers. While at one end, desktop computers were getting their shape, at the other end at Xerox Parc lab, scientists had other thing in mind. They wanted computers to be distributed but communicating with each other as per requirement, therefore they reducing requirement of the central processing capability. Computation could have been done at various places of the system by transferring the data between the components within the network.

There have been three major waves in computing so far, as far as the human-computer interface is concerned (Figure 1). First was in 1960s, when transistorized mainframe computers were available. Here, single computer was shared by many people. Second was in 1980s, when need for more computers brought us in the era of personal computers and notebooks which achieved the ratio of one computer per person. As a result of advancement in embedded systems, networking and information technology, increased computation power was available at affordable costs. This resulted in the usage of multiple computers by single person.
Consequently, the third wave in computing began in 1988, when Dr. Mark Weiser, Chief Technologist at Xerox Palo Alto Research Center (PARC) coined the term ‘Ubiquitous Computing’. Ubiquitous means everywhere, omnipresent. It refers to the trend that humans interact with a set of small multiple computers simultaneously. These computers are often connected in a network and are embodied in everyday objects in the environment. Thus, they simply become part of our life without being explicitly noticed.

Weiser wanted mobile and embedded processors to communicate with each other and surrounding infrastructure and smoothly support their operation to coordinate everyday work practices. Sensors, circuits and processors all need to be networked wirelessly. To achieve this, each of these devices need to limit its range of communication to make reuse of valuable bandwidth. Therefore, he tried to explore techniques for special use of radio spectrum and introduced concept of bits-per-second per-cubic-meter to the UbiComp vision [6].

Weiser also described UbiComp as “The coming age of calm technology”. UbiComp always tries to make computation calmly, unlike PC which tries to virtualize human world. UbiComp tries to push computerized version of technology back into physical world [6]. For example, where a PC can give you a graphical printed page on its screen to read a virtual book, UbiComp tries to create a dedicated embedded device exactly like a book which you can hold in hands just like physical book so you would never notice that you are reading a virtual book.

UbiComp is still a novice & evolving computing paradigm with the aim of supporting users in an omnipresent manner. This computing realm is very different to first generation mainframe computers and second generation desktop computing as it aims to support computation for anyone in anyplace at any time. End-devices such as smart mobile phones were not designed as computer devices but as a byproduct of system integration and micro-architecture-ism providing significant computational power that can provide additional services to end users.

III. Growth, Applications and Challenges

Since 1988, three major building efforts were taken at PARC within the Ubiquitous Computing program - LiveBoard, ParcPad and ParcTab.

In 1992, PARC presented LiveBoard. It was an attempt to build a directly interactive, stylus-based, large-area display for use in computer-supported meetings (Figure 3). It was a beginning to develop and evaluate user interfaces for group meetings, presentation and remote collaboration. The Liveboard project fitted into the broader scheme of ubiquitous computing for the workplace of the future [2].

In Liveboard, image was projected from a digitally addressed LCD. It also incorporated a rear projection screen which could be easily seen at oblique angles by the group of people standing around the liveboard. It also incorporated a wireless pen with four distinct states for drawing, popup menus or to provide other input controls. These states were controlled by switches on its body and pressure sensitive tip switch [5]. The limitation of Liveboard as per the users was that the pen resolution was not good enough to provide an improved user experience over a whiteboard [2].

Later, in 1995, Computer Science Lab (CSL) started two programs to create smaller computers: ParcPad and ParcTab. ParcPad was book-sized and ParcTab was palm-sized computing device. In ParcTab project, CSL integrated palm sized computer into office network [3]. It also introduced features like Email, group window, group voting, remote control in the product [2]. This ParcTab project was used by Xerox as a test bed for its futuristic philosophy- The Ubiquitous Computing.

Tab used 10 kbps, diffused infrared signaling for wirelessly communicating with ceiling-mounted base stations. Every room had a base station providing an infrared wired microcellular communication network. Each base station communicated through a wired connection to a workstation attached to building’s Ethernet. So ParcTabs were effectively passive terminals generating events according to user actions and sending them to remote servers in the network running...
some applications. Then, the response of the application was sent back to tab displays.

![Figure 5: Xerox's ParcTab][2]

ParcPad also used similar design approach but it used low-bandwidth X-protocol across a radio link to communicate with a base station through a short-range near-field radio at 250kbps.

In 2000, IBM came with Linux Watch and in 2001 it launched IBM WatchPad 1.5. It was a wrist mounted embedded computer running Linux 2.4 on an ARM processor with integrated fingerprint reader, Bluetooth, infrared, speaker, microphone, touchscreen and push button interfaces. In September 2014, Apple has put forward the design of AppleWatch, which is another upcoming wearable computer. Besides knowing the time, you can dial and receive calls, texts, use Wi-Fi, maintain physical fitness, get navigation information by using various integrated gadgets and apps.

People were able to interact with these devices by touch panel or switches. With the type of devices in the current market, you can interact using natural language voice commands. An example for this is the Google Glass. The prototype resembles standard eyeglasses with optical head-mounted display instead of lenses. This device can be called truly wearable as you do not notice its presence explicitly. You can use its many features by keeping your hands free. Photos, videos, email, surfing internet, gogglung, navigation etc. all this can be done just by talking with the device. Beside voice interaction, it also has touchpad, using which user can swipe through timeline-like interface on display. You may want to show the world, what you are seeing at some special occasion. You can simply share the feed with your friends in real time and make them part of the experience.

Work is being done in healthcare sector to make use of wearable computing technology to solve health related issues. For example, this technology can be used to help people see better, remember better and function better. Today, we can use corneal transplants in treatment of defective vision. In future, visually challenged person can simply insert artificial eyes with zooming, infrared sensors and night vision facilities and will experience a super vision power. As an example, The MindMesh, an EEG-based (electroencephalogram) thinking cap, has been developed which allows wearer to add different external gadgets to his brain.

![Figure 4: GoogleGlass – The wearable computer][8]

IV. Conclusion and Future Scope

If you want a computer display, it can appear in thin air, or be attached to a wall or projected onto any other surface. If people want to watch TV together they can agree on where the screen should appear and what show they watch. When doing your work, you can have screens on all your walls, menus attached here and there-however way you want to organize your things!

It goes beyond this—does your house need a new coat of paint? Don’t bother, just enter it into your public database and you have a nice new mint green paint job that everyone will see. Want to redecorate? Do it with computer graphics. You can have a bird bath in the front yard inhabited by Disneysque animals who frolic and play. Even indoors, don’t buy artwork, just download it from the net and have it appear where you want. This way you can change your décor theme instantly.

So computers are shrinking in their size and they are getting integrated in our lives. Few years later, we may not even recognize the presence of the computing device which is taking care of us more than we would take care of ourselves!

References

Ubiquitous Computing/Pervasive Computing is one of the most visionary technologies that are being sought after by many researcher and companies today. The pioneer in the field of computers and research, Mark Weiser, was the man who coined the term Ubiquitous Computing (UC). It was in year of 1988 when, Weiser first came up with this term.

The most important thing which distinguished Mark Weiser from other researchers of his time was that he had a vision for the future and that was reflected in many of his works. As he once legendarily quoted, “Ubiquitous computing name’s the third wave in computing. First wave included mainframes, each shared by lots of people. Now we are in the, second wave, the personal computing era, where person and machine are staring anxiously at each other across the desktop. Next comes the third wave of ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives.”

Although Mark worked for multiple startups related to computer technology, his seminal work was in the field of Ubiquitous Computing. He was leading the computer science laboratory at XEROX PARC, which he had joined in 1987. While working towards Ubiquitous Computing, Mark predicted future in which PCs will be replaced with invisible computers embedded in everyday objects. He believed that this would lead to an era of “calm technology”, in which technology, rather than be a foe, will ultimately be a friend helping us to focus on and help take important decisions. Thus, he earned the tag as the father of UC.

Mark Weiser graduated in Masters in Computer and Communication in 1977 from University of Michigan, College Park. Later on in 1979 he received a Ph.D. from the same university. Later Mark was made faculty and was on board for 12 years at same university. In 1987, he joined Xerox PARC as a research scientist, and consecutively he was made head of the Computer Science Laboratory. In 1994, Weiser was nominated as Director of Laboratory. He worked there for two years and returned to Xerox as its Chief Technology Officer at Xerox Palo Alto Research Center (PARC).

Mark outlined a set of principles describing the necessity of ubiquitous computing. These principles include:

- The purpose of a computer is to help us do something else.
- The best computers are quiet, invisible servants.
- The more you can do by intuition, the smarter you are; the computers should extend your unconscious.
- Technology should create calm.

Mark’s work was largely prejudiced by his father’s reading of Michael Polanyi’s “The Tacit Dimension”. He had to face a lot of criticism from his fellow researchers. Many researchers were staggered at the audacity of Mark’s vision. However, overcoming all the obstacles, he proved them the significance of his thinking. A close colleague, M Satyanarayanan in his tribute said, “Many wanted to prove him wrong and were skeptical about his success. It was during the time when World Wide Web did not exist, laptops were bulky in size and no one had even heard about PDAs or wireless networks. 

While on other hand, Dough Terry one of very close associate with Mark once had mentioned about the infectious energy Mark had. Besides that he also mentioned about his love for technology. In one of the lectures he said, “He loved to rave”, Doug recalled. “He had a passion for technology that I’ve rarely seen in someone.”

In the later part of his life, Weiser discovered his flair for writing and authored more than 75 technical books and papers. Mark was also a gifted drummer, and was a part of the rock band ‘Severe Tire Damage’. It was the first band to perform live on the Internet in 1993.

The impact of Mark Weiser’s research and study is still strongly felt in the Computer Science literature. Even today his work is widely cited by those especially working in the Human-Computer Interaction (HCI), UbiComp and plethora of associated sub-agendas/genres of computing field. In his vision-led research ethos, Mark was able to maintain a balance between what we identify as fact/fiction, art/science and successfully devised an ethos (or ‘cult’, following Gold) for alternative thinking about technology use. As Seely Brown remarked in an epilogue to one of Mark’s last publications: ‘For Mark, sharp boundaries between the social and the technical, between the artistic and the scientific, and between work and play never existed’.

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Areas of Interest
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Intricacies of Ubiquitous Computing

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I. Introduction
Waiting with bated breath for the latest Apple iPhone to hit the commercial markets? Can't wait to hold on your own pair of those classy Google glasses? Raring to go berserkon that Xbox One & Ps4? If your answer is yes then you are already poised for the fascinating world of Ubiquitous Computing. As technology becomes more & more embedded in everyday artifacts, Ubiquitous Computing (UbiComp) promises a life in which our tasks are powerfully, though invisibly, assisted by computers. Ubiquitous Computing offers a “Matrix-like world”, where dynamic, ad-hoc systems will lead to unprecedented efficiencies and possibilities. However, this vision entails tremendous considerations towards making it a reality. So what are the factors to be considered while designing a Ubiquitous Computing System? This article attempts to find answers to this question.

The notion of Ubiquitous Computing emerged even before its closely related fields of Mobile Computing and Distributed Systems based Information and Communication Technology (ICT) achieved reasonable maturity. Yet the research in these two fields complements that in the field of Ubiquitous Computing as can be seen in Figure1. For instance, you are on your monthly trip to the grocery store. How about some assistance with the shopping! Consider the trace of a person beside you, walking over walls & racks at times, to help you with your shopping nitty-gritties of the likes of updating your shopping list as per the racks you encounter, announcing discounts of your favourite apparel brand as you move, keeping an eye on the serpentine queue at that new coffee shop, all while you shop! Such a system would involve considerations like remote information access mechanism, location sensitivity & smart spaces enabling technologies, apart from various others.

Concerns such as these & many more, faced during implementation of a UbiCom System can be broadly classified under the areas indicated by bullets in Figure1. New challenges are encountered as one moves from left to right in this figure. In addition, the solution of many previously-encountered issues becomes more complex. Hence, it becomes more difficult to design and implement a ubiquitous computing system than a simple distributed system of comparable robustness and maturity.

In the following sections, we talk about the complexities of the UbiComp architecture and address the issues involved at various levels of implementation.

II. Design Framework for UbiComp: Smart DEI
A glimpse at this strange new world reveals a picture where the smart medicine cabinet knows the expiry date of its contents or the smart mirror allows the curious lady to see herself in all those dresses without wasting her time in trying them all! Interested to know what would it take in making this fascinating world a reality? Well, we have all the enabling technologies which if managed suitably can achieve this higher goal of ubiquity. These being Processing, Storage, Networking, Display, Sensing & Actuation technologies. All UbiComp systems support three basic architectural design patterns: smart Devices, smart Environments & smart Interaction (Smart DEI). ‘Smart’ means anything which is active, digital, networked, autonomous, reconfigurable and has a local control of its own resources like energy, data storage etc. Such a smart DEI framework provides the base on which an UbiComp system can be analysed & designed[2].

In light of ubiquitous computing, properties like Distributed, iHCI, Context Awareness, Autonomy, and Artificial Intelligence stand out as follows:
- Devices need to be networked, distributed and transparently accessible i.e. technology should not be obtrusive to the user.
- Human Computer Interaction (HCI) needs to be more invisible i.e. implicit (iHCI).
- Devices in the environment need to be context aware in order to perform optimally.
- Devices need to autonomously operate without human intervention.
- Devices can handle a multiplicity of dynamic actions and interactions, governed by intelligent decision making which may entail some form of artificial intelligence in order to handle:
  - Non deterministic interactions
  - Competition and cooperation between members of organisation
Better interactions through sharing of context, goals, etc.  
To model an UbiComp system’s interaction with its external environments, the following basic types of interactions are considered:  
- between computer systems and humans as systems (HCI)  
- between computers and the physical world (CPI)  
- between ICT system devices (C2C)

III. Context Awareness

The UbiComp world thrives on the notion of supporting ubiquity, or everywhere-ness, based on “context”. Context is any information that can be used to characterize the situation of a person, place or object. Contexts supported by an UbiComp System may be:

- **Physical environment context**: related to physical world parameters (e.g. location, body temperature of user).

- **Human context** (or user context): pertaining to the user such as user’s identity, habits, to-do-list etc.

- **ICT context or virtual environment context**: wherein a device in the distributed system knows whether a service is available locally or remotely.

The approach to context-aware application development is to obtain information about the context, or situation, through automated means, take decisions on behalf of the user (or with minimal intrusion to the user) and accordingly modify the environment. Can a ubiquitous computing system imitate such an intricate behavior peculiar to mostly humans? Challenging task, isn’t it? Hence, the following issues emerge:

- **How to represent context internally?** – For example: how to process sensor (a context source) data?

- **Where to store?** - Locally or in the network or both?

- **How often to update and consult context information?** – For example, if the user location is changing then context needs to be updated frequently.

- **How to track location?** – For example, GPS in smart phones.

- **How to sense the surroundings?** – Use sensors (e.g. how much ink is there in printer’s cartridge).

- **How useful is historical context?** – depends on application e.g. appropriate when the user follows the same daily routine.

Figuring out the answers to the above ‘How’s’, as attempted to some extent (here), will help the application designers select the most suitable of the available context & structure the same in applications.

IV. Adaptation Strategy

Certain scenarios may force an UbiComp system to rework itself. A significant such stimulus could be the all-embracing Supply-Demand imbalance. UbiComp applications may require locking horns for resources like Bandwidth, Energy, Memory & so on. Easing out this situation may involve strategizing on the lines of:

- **Compromising on the quality, or fidelity, of an application.**

- **Forcing an increase in supply to meet the application’s demand as per some reservation.**

- **Suggest a corrective action to the user. E.g. go to location ‘x’ for plenty of that resource!**

Though helpful, these adaptation strategies result in more questions than answers. To mention a few:

- **What drives the choice between these strategies? How to make switching amongst them effortless?**

- **What reservation policy to follow?**

- **Will corrective actions be annoying to the user? How to implement them?**

- **What are the ways to lower fidelity across varied applications?**

The fairly advanced fields of Mobile Computing and Distributed systems may become the guiding light for the developer in his quest to find answers to the above & many more such intricacies of the UbiComp world.
V. Implementation Issues

Actual realization of a ubiquitous computing system will require addressing many complicated design and implementation problems. Specifically speaking, ubiquitous computing incorporates four major research issues (in addition to those in Mobile Computing & Distributed System fields) into its agenda, as was illustrated in Figure 1.

Effective Use of Smart Spaces

Realizing Smart Spaces would involve embedding Computing Infrastructure in building infrastructure, so as to allow the sensing & control of one by the other. For e.g. a smart room capable of automatically adjusting features like temperature, lighting levels, etc. to work in tandem with the electronic profile of the inhabitant. Such a smart space would be a valuable resource in the UbiComp world & should be exploited to its maximum potential. Thinking on the lines of the following could be helpful:

- Which embedded system to incorporate?
- How to ensure mobility management & energy management?
- What would be a suitable composition of Services, I/O matching and adaptation strategies?

Invisibility

iHCI or Invisibility requires the system to be able to reliably & accurately meet user expectations with minimal user interaction, thus rarely presenting him with surprises. However, at times it would be more beneficial to have an “opaque” interaction rather than a completely “invisible” one. Here, the word “opaque” is used in the sense that system requires to be intrusive to some extent to avoid a bigger setback later— much as pain alerts a person to a potentially serious future problem.

Localized Scalability

The magnitude of interactions between a user’s personal computing space and his surroundings increases as the number of smart spaces involved grow. For instance, it becomes difficult to manage the bandwidth and energy requirements for a wireless user who is continuously on the move. Presence of multiple users will also add to the complexity. In this case, efficient scalability can be achieved by strictly reducing interactions with objects beyond a certain distance.

Masking Uneven Conditioning

The extent to which a particular space is “smart” varies across different environments— what is available in a well-equipped conference room or classroom may be more sophisticated than in other locations. As a user moves through these environments, the variation in “smartness” is distinct, killing the very concept of “invisible” technology. Masking uneven conditioning of environments then becomes indisputable. Development of masking techniques focusing on reducing this variability would be more fruitful than working towards complete invisibility.

VI. Conclusion

Ubiquitous computing offers new beginnings for the adventurous and the restless — a rich open space where the rules have yet to be written and the borders yet to be drawn. This article portrays the fact that the concept of Ubiquitous Computing is quite simple, yet understanding its intricacies is a task which encompasses different research fields. It presents the framework on which an UbiComp system can be built. In conclusion, it can be said that, understanding & resolving the intricacies discussed throughout this article, would serve as the key to the success of Ubiquitous Computing.

References


[5] FriedemannMattern,’From Smart Devices to Smart Everyday Objects’,Institute for Pervasive Computing, Zurich
Merriam-Webster defines the word Ubiquitous as “existing or being everywhere at the same time; constantly encountered; widespread”. Which makes ubiquitous computing system (or Ubicomp in short) the computers that are so mobile and smart, one actually can wear them as accessories. The book “Ubiquitous Computing Fundamentals” by John Krumm, a Microsoft researcher, is an excellent compilation of 9 articles written by different researchers who dedicated their research to this field. These authors mostly are professors from reputed universities or working with esteemed research laboratories. This book provides a finest walk-through into the background and history, various attributes and data analytics of Ubicomp. What makes the book even more interesting is that, it is full of case studies and innovative examples along with the images in every chapter. Here are few of them to tickle some brains: a chorded keypad as a one-handed typing input device; cellphone based whereabouts clock that gives the location information of all the family members; an active ultrasonic badge that provides accurate three-dimensional positioning within a room; eyeglasses that take us to a virtual reality; and so on and so forth.

The first chapter sets up a background on Ubiquitous Computing as a basic concept. Roy Want, a researcher at Intel Corporation has lived up to the responsibility to make the readers well-versed with the history, evolution and numerous applications of this smart technology. The author discusses work done at various laboratories across the world, to throw some light on their contributions in this third era of computing techniques, starting right from XEROX PARC where it got its title. Mark Weiser, the then director of Computer Science laboratory, did not just coin the term Ubiquitous Computing in year 1988, but he also envisioned the future with it. A future where all computing devices will be a part of our everyday artifacts and will help us manage our chores at work as well as at home. Further, the author takes us to the universities such as University of Tokyo, UC Berkley, MIT, Georgia Tech, Lancaster University for a good amount of exposure to the research carried out in these universities regarding these “wearable computing” techniques. While explaining the research, innovative wearable products are also discussed, such as eye-glasses with head-up display, a cup that tells you if a coffee is too hot or it is being tipped at a critical angle, etc. Research contributions by other research laboratories such as Hewlett Packard, IBM, Intel, Microsoft, are also mentioned at length.

Beyond all the case studies and the innovative examples, the next chapter talks more in the ‘how’ part rather than ‘what’. Jakob Bardram, a researcher at University of Copenhagen and Adrian Friday from Lancaster University discuss about the challenges in Ubicomp systems such as: How to design the hardware for ubiquitous location computing with examples of ultrasonic techniques, RADARs, Surface User Interface (SUI) and Ambient User Interface (AUI) are also discussed here.

Alexander Varshavsky from AT&T Labs and Shwetak Patel, from University of Washington throw some light on the location information analysis in the next chapter. This could be 1 mm using magnetic field or tens of kilometers using FM radio signals. This location data helps a great deal in numerous applications such as: signal strength optimization, measurement of the time-of-flight, troubleshooting analysis in a device failure conditions etc. The authors discuss various methods involved in the ubiquitous location computing with examples of ultrasonic techniques, RADARs, Cameras, etc.

The next chapter “Context-aware computing” discusses a very interesting concept of the ‘context’ for the computer. Can a computer comprehend the references of ill-structured input commands and be able process it? The author Anind K. Dey, from Carnegie Mellon University, explains that one of the keys to achieve context-awareness for a computer is in establishing the basic knowledge of the location, user behavior and through learning algorithms.

The last chapter is written by John Krumm himself where, sequential sensor data processing techniques are explained in the view of inaccurate sensor data handling and processing of noisy data. The author highlights the need of the noise reduction and filtering the noisy sensor data using mean and median filters. The last chapter gives a pretty good closure to the expedition the book has started on the topic. The editor makes sure that not only all the attributes to the ubicomp are covered in this book but also guarantees that, they are accompanied by latest innovation examples and breakthrough technologies.

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**Areas of Interest**

Mathematical Modelling and Simulation, Control systems
Automotive Perspective of Ubiquitous computing

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Enterprise Architecture (IT),
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Ubiquitous Computing, the term Ubiquitous means omnipresent, i.e. being everywhere at the same time.
Using IT + embedded technology this concept is implemented through mobile, wireless network devices and devices with UI & no UI, microprocessors and sensors.
Ubiquitous computing finds its use in varied applications like agriculture, health care, automotive, education, IT, retail, transportation and logistics and so on so forth. So, let's take a look at its applications from the automotive domain perspective.

Automotive
I. Introduction
'Wheel' is one of the greatest inventions in the history of mankind. It has brought the world boundaries closer, within reach. Today we just cannot imagine our world without it. After centuries of evolution, discoveries and innovations, today we have altogether a whole new domain known as ‘Automotive Industry’ with super cars, hybrid cars, smart cars, superbikes and advanced vehicles designed by modern technology.
However automotive domain is still on the path of evolution, especially in India. Globally, big countries are way ahead in terms of safety and technology related to vehicles.

II. Why Ubiquitous Computing in Automotive?
WHO (World Health Organization) report 2013 states that globally 1.24 million fatalities took place due to road & motor accidents in 2012. India ranks no.2 in this list i.e. with 2, 43,475; deaths right after china i.e. 2, 75,983. These are alarming figures and show our negligence towards road & motor safety. To overcome these issues we need to ensure optimum utilization of existing technology and work towards developing advanced technologies for safe and comfortable driving experience.

III. Existing Technologies in the Automotive Domain
Vehicles need accurate and real time data, which can be used to formulate intelligent quick decisions, which the traditional computing cannot do or would otherwise, need a lot more time and processing. This in turn has given birth to a lot more smart devices & technology. The ubiquitous computing takes these systems to the next level by adding mobility and accessibility to it. Today we have M2M (Machine to Machine) and Telematics trends coming up, which will revolutionise the automotive industry and these are nothing but another form of Ubiquitous computing/IOT (Internet of things). Different industrial arms such as Telecom, IT are becoming crucial part of this industry.
There are various existing technologies such as RFID (Radio frequency identification) systems, VANET (Vehicular ad-hoc networks), wireless sensor networks, USG (Ultra sound generator), electronic stability control (ESC), adaptive cruise control (ACC), sonar vision, GPS/Satnav system, etc. Leveraging these technologies efficiently will change the industry dynamics & the way we interact with these vehicles. Today, these technologies are available only in high end luxury passenger cars and few commercial vehicles, our objective would be to design these for basic cars, affordable to the society.

IT &Telecom sector will play an important role in the Automotive Industry. IT industry will develop intelligent algorithms to embed them into these devices for quick decisions. Telecom companies are slowly migrating to IP based networks (Ex: Reliance Jio). This IP based networks are far more robust, efficient, and faster in speed as well as they are cost effective, offering users 24/7 seamless connectivity. With robust infrastructure it would be feasible to communicate between these vehicles through IP based networks.

IV. Applications of Ubiquitous Computing in Automotive domain for Vehicle & Road safety
Passenger Vehicle Segment
ACC (Adaptive cruise control) is different than just a normal cruise control technology. It automatically accelerates & de-accelerates vehicle speed to keep safe distance from a vehicle in same lane. This is achieved through a forward looking radar headway sensor fitted in vehicle grill, digital signal processor, & longitudinal controller. Refer fig:1.1

Fig: 1.1 Cruise Control Logic

2. Electronic stability control (ESC)has a decade-long presence in the automotive industry and is known by different names such as Electronic stability program (ESP) by Audi, Advance Trac by Ford, Stabilitrak by GM, and Porsche Stability management by Porsche. However, in India it is hardly seen in low segment vehicles. ESC takes care of two
important situations such as Understeer (when front wheels lose traction) and Overseers (rear wheels slide, causing car to spin) especially, when the road is slippery. Three sensors play an important role in the electronic stability control system, they are: wheel-speed sensors, steering-angle sensors and rotational-speed sensors synced with vehicle’s on-board computer (refer fig: 2.1). ESC works along with ABS (Anti-lock braking system) & traction control of the vehicle, stopping the vehicle swinging too far in any direction by activating one or more individual brakes and thus keeping the vehicle stable on road (ref fig: 2.1)

Fig: 2.1 Fatal situation without ESC

3. The Volvo’s Pedestrian detection system with Full Auto Brake consists of a newly developed radar unit integrated into the S60’s grille, a camera fitted in front of the rear view mirror and a central control unit. The radar’s task is to detect any object in front of the car and to determine the distance to it while the camera determines the type of object. The system can detect pedestrians who are 32 inches tall and higher, including children (Refer fig: 3.1).

Fig: 3.1 Modern Day Radar Systems

4. Connected-Car Technology or Telematics is a wireless communication that is established with the help of embedded cellular device technology between vehicle to vehicle, vehicle to human, & vehicle to cloud. With this technology, the cars would be able to communicate with other cars in surrounding without human intervention. These smart cars, which would communicate information and data through different devices in the vehicle will ensure safe and secure driving conditions on the road.

Following are the key services provided today:

- **Safety and security services**: Automatic crash notification, emergency & medical assistance,
- **Road side assistance**: 24/7 breakdown services in remote areas, where the GPS device search for the nearest service station automatically and alert them,
- **Navigation assistance**: Turn by turn satellite based accurate navigation assistance,
- **Traffic assistance**: Automatic toll collection, location based services for real time traffic updates to avoid further congestion on roads and assisting in alternate route saves time and fuel up to large extent,
- **Diagnostics**: Remote diagnostics of vehicle, performance data collection by insurance and car companies to keep track of vehicle condition,
- **Infotainment services**: Direct music/video downloading, internet radio, streaming content and synching it with i-cloud/remote server. (Ref: Hughes Systique Corporation)

### Commercial Vehicle Segment

Fleet Management System & Public Transport system

India has a road network of over 4,689,842 kilometres; the second largest road network in the world. Major day to day essential and other expensive goods transport takes place via road through heavy laden trucks and lorries. To keep track of each and every vehicle is tedious process for the medium as well big transport operators; it consumes lot of time and money, and no assurance of accurate location update. Thus, fleet management system comes to rescue.

Fleet management system uses GPS technology, where one can track the vehicle and navigate. Tracking ensures that the monitoring system based at transport company can locate where exactly the vehicle is moving; and whether it is on right path or not. The navigation helps driver to find the correct path and reach the destination. Device like TELTONIKA FM1200 operates similarly on GSM connectivity, continuously connected and updating data on cloud.
It also has some very good features such as, Fuel management, Driver Identification, Collision management system. Here, it’s not just usual fuel management system; it alerts driver if the fuel reaches critical level as well as sends notification to system administrator. The Driver identification module allows only the authorised person to start vehicle engine; thus, it averts unauthorised use of that vehicle. Collision management system detects any hurdle in the path & alerts driver, also in case if the driver is deviating outside the lane he is driving in.

This technology can be implemented in public transport vehicles were thefts and misuse of any vehicle can be prevented. Also if public transport vehicles are equipped with GPS devices and connected to cloud, the traveller can locate where the vehicle is via specially developed smart phone application, thus offering users mobility, accessibility, and convenience.

Revolo

Let’s consider a scenario of Revolo, a hybrid car technology indigenously developed by KPIT.

- The on-board computer displays each and every detail about the cars diagnostics, what if it is connected to a centralised system via cellular network and real time monitoring of car is done while simultaneously data is stored on cloud.
- The on board computer continuously monitors the battery status & checks whether it needs to be charged and at the same time also locates the nearest charging station displaying on GPS/ Satnav system.
- Even locating and communicating a nearby Revolo car would be possible via GPS device.
- Sensors will detect any major impairment to any part and alert the driver as well as simultaneously storing that data on cloud for further analysis.
- Voice recognition commanding will take the driving experience to the next level.

(Ex: If the user says “Revolo search the nearest restaurant” & it would display the list of available restaurants in vicinity on your GPS device)
- Switching from battery to fuel and vice versa can be intelligently managed by sensors in car avoiding it breakdown in traffic conditions.

Global Innovations

Intel Drive-in vehicle is based on Internet of Things (also Infinity InTouch, BMW Connected Drive). Cisco is working on M2M & Connected Cars Technology. Google car is another example of Ubiquitous Computing in Automotive domain.

Big data will play important role in automotive domain, because it has the capacity to process enormous amount of data generated by a wide array of sources like vehicle sensor data, warranty claims, vehicle maintenance data, which is continuously stored on cloud. Big data analytics will give accurate figures and precise results and predictions round the clock.

Challenges ahead

However, there are some challenges and barriers like intelligent algorithms and complex design implementation, safety, widely varying industry dynamics, regulations etc. Along with that, humongous data will be stored on cloud accessible to users 24/7. We need high end security and firewall solutions. And this can be definitely tackled, thanks to continuous development in cloud and security.

Conclusion

Ubiquitous Computing has remarkable economic potential and we can definitely expect further R&D and Innovation to take UC in Automotive to the next big level in the coming years.

![Figure 4](Source: sites.tcs.com)
Fig: 5
Figure 5 shows how Internet of Things can be achieved in Automotive (Fleet management, Toll collection, Traffic management is made lot more convenient via use of Internet through different network mediums) (Source: Electronicdesign.com)

Bibliography


White Paper: The Quest for Telematics 4.0 (Ernst & Young)


IRACST White Paper: Fleet Management Solution by Dashmir Istrefi & Betim Çiço


INTERESTING FACTS

Emails and Spam Facts

- 60 billion emails are sent daily, 97% of which are spam.
- Spam generates 33bn KWt-hours of energy every year, enough to power 2.4 million homes, producing 17 million tons of Co2.
- 9 out of every 1,000 computers are infected with spam.
- Spammers get 1 response to every 12 million emails they send (yet it still makes them a small profit).

Social Media

- A “twillionaire” is a twitterer with a million or more followers.
- There are some 1 billion computers in use.
- There are some 2 billion TV sets in use.
- Facebook has 500 million registered users… and still about 100 million less than QQ – a Chinese social media portal.
- About 20% of the videos on YouTube are music related.
- 24 hours of video viewing is uploaded every minute on YouTube.
- People view 15 billion videos online every month.
- On average, US onliners view 100 videos per month each.
- Flickr hosts some 5 billion photographs, Facebook hosts more than 15 billion.
Early Automotive Failure Detection Using Social Media

About the Author

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I. Introduction

Today’s automobiles are packed with sensors that detect everything from the amount of oxygen in the exhaust to the location of the vehicle. These sensors collect valuable data during the operation of the vehicle and the data can be used to monitor the health of the system. The data can also be used to diagnose problems with a vehicle when the sensor readings are out of specification. While the number of sensors and computers in a vehicle are growing rapidly, they are limited in their capability because they can only diagnose what they are designed to monitor. They can tell when the exhaust is out of specification and turn on a warning light, but they cannot tell when the gas pedal is sticking or an ignition switch is not operating properly. These types of failures require more data collection than the typical automotive computer can collect and often need to collect environmental data about the situation.

Humans are still the most ubiquitous sensing platforms on the planet. They are capable of detecting intermittent failures, such as a sticking gas pedal and describing in detail the scenario around the situation. For example, “I was driving through a parking lot and while making a right turn, I started to slowly accelerate when the car took over and rapidly accelerated”. They can also describe the environmental conditions leading up to the situation such as weather and road conditions that cannot be extracted from car sensors today.

Now that a situation has occurred and the human sensor has collected data, there needs to be an easy way for the data to be reported. Unfortunately, many situations go unreported as the human has no idea where to report the information or, more commonly, may attribute the situation to an error on their part. So, while a situation has been identified and data collected by the human sensor, the data remains unusable for analysis. What is needed is a way to listen passively for signals that indicate a situation might have occurred so that a direct contact can be made to collect the data from the human sensor.

Enter social media, today’s most ubiquitous communication platform. Social media has transformed the way people communicate. Twitter is the most widely used social media platform for providing bursts of information. These burst of information can often be random streams of consciousness for example “I’m having sum wonderful delay’d dreams bout ‘green sticky fields 4-ever’ but they could also contain valuable signals about a situation of interest.” For example: “Wow, almost slammed into a post F-Prius”. While not very descript, this could be a signal that more data needs to be collected.

This paper examines how passive listening of social media streams might be used as an early failure detection system. We will explore the use of machine learning to identify trends and the use of social networks to collect extended data on a situation for analysis. We will also explore the use of cloud computing as a cost effective platform for dynamically scaling a solution.

II. Business Discussion

Automotive recalls cost corporations tens if not hundreds of millions of dollars excluding the impact on their brand and their customers. Many intermittent problems take years to manifest themselves. Once identified, data can then be collected and analyzed. During this period, more cars are rolling off of the assembly line into ‘customers’ hands which increases the likelihood of a potentially catastrophic failure.

Early warning systems have been used for years to detect underwater earthquakes which can cause tsunamis and to detect incoming inter-continental ballistic missiles. These systems have been deployed globally and watch passively around the clock for situations to occur. To avoid false alarms, these systems are very good at filtering out noise, and multiple systems have been deployed to help confirm a situation that has been detected by one or more of the systems. These systems provide real-time alerts to those on the ground giving them time to react to the situation and to inform the public of the pending danger before the situation gets worse.

Could an early warning system be designed to identify when a consumer product, like an automobile, is beginning to shows signs of irregular behavior? Such a system that would passively listen to streams of information searching for clues. The system could ingest massive amounts of data, filtering out the noise and reporting on potential situations that need to be investigated. Once a potentially risky situation is identified, the system would then be able to follow-up on the provided information to seek clarification and additional facts to expedite understanding and evaluation. While a system like this could save the manufacturers lots of money and provide for quicker issue remediation, it could possibly identify the failure early enough to avoid catastrophic systems failures.

Social media collects volumes of information from millions of users ranging from birthday parties to world events. This information is given up voluntarily and submitted whenever the user chooses. The information could be submitted seconds or days after an incident depending on the platform. Twitter is the social media platform used the most for real time communication. While this torrent of
information might contain valuable bits of information, the sheer volume of data makes it difficult to analyze using a typical desktop or server environment. Given the dynamic nature of the data, the frequency and quantity varies significantly over time, requiring a system that can scale to meet demand. To create a passive listening system for Twitter data, a system needs to collect and queue the streams of data, use machine learning algorithms to filter out the noise and classify the data, and then trigger an action to follow-up with the author to collect additional data on the reported situation. For example, say a "Tweet" was parsed that read “Wow, almost slammed into a post #Prius”. This incident was of interest because of its reference to a car model and a potential serious situation. Follow up with the user might reveal that the user skidded on black ice and lost control or that the gas pedal appeared to stick. If the follow-up indicated the gas pedal may have stuck, this information would be stored and analyzed with future validated situations.

Creating a sandbox to sample, clean and classify data in a test environment is relatively straightforward and can be performed on most common computing environments. Scaling this cost effectively to billions of data points requires the use of ubiquitous computing such as Amazon Web Services (AWS) and requires an architecture that can be rapidly expanded and contracted to meet demand.

III. Solution Discussion

Figure 1 shows a general purpose, scalable architecture for using machine learning to classify social media output from Twitter. It can be applied to the specific incident reporting application described.

The architecture here is designed to be run on a scalable, ubiquitous computing platform, such as Amazon’s Elastic Compute Cloud (EC2).

Note 1 – Twitter provides several different levels of real-time API access to the developer community for them to access publicly available tweets. There is a search interface for returning all tweets with keywords, a bounding box interface for returning all tweets within a geographical area, and the ‘firehose’ interface, which returns “all” tweets. Access to these APIs is free, with the exception of the firehose interface, which Twitter charges for. In addition to the tweet itself, Twitter provides several fields of metadata, including the identification information for the person authoring the tweet, when the tweet was sent, and where the tweet was sent from (if the author allows that information to be public). This format for all of this information is provided by Twitter in JSON (Java Script Object Notation).

Note 2 – Depending on the amount of Twitter traffic expected for the application, multiple ingestors can be used to capture the data. The purpose of the ingestor is to interact with the Twitter API, gather the candidate tweets, and store them for enrichment and analysis. The only logical differences between the multiple ingestors would be the search criteria they are sending to the Twitter API, which is configured at launch time of the ingestor.

Note 3 – The purpose of the data store is to collect and store the tweets, and also to make them available to other tasks for enrichment.

Note 4 – The social media classifiers have one job: to determine if tweets are relevant to the data problem attempting to be solved. In this architecture, every tweet collected is classified as relevant or irrelevant. Unlike the ingestors, each one of the classification machines is exactly identical, with the number in use being proportional to the amount of tweets that need to be classified, and the classification logic being loaded at machine boot time.

Note 5 – The analytics user interface is how the results of the analysis are presented to the end user so that the proper course of action can then be determined.

Note 6 – The system monitor is a single machine that determines the health of the network, and determines if the current amount of computing (ingestors, classifiers) is appropriate for the load. In the event it is not, the monitor has the power to create or destroy ingestors and classifiers, as needed.

I. Case Study – Detecting the Outbreak of Contagious Diseases

In 2012, the United States Department of Health and Human Services (HHS) sponsored
effectiveness of using Twitter to try to detect outbreaks and the spread of contagious diseases during the very early stages of an outbreak. If so, this might be one of the earliest indicators of a public health problem, and allow HHS to take appropriate action. To facilitate this, HHS put out a list of 50 diseases they wished to track. Some of these (measles, mumps, chicken pox, etc) were very specific, while others (cold, flu, etc) were extremely vague.

The challenge was threefold – collecting the tweets, determining if a tweet is relevant to the analysis (“I just caught a cold from my friend!”), “Man, having a cold sucks!”) or irrelevant (“I ordered a pizza, and it got here cold!”), “A new cold medicine has been invented”), and determining the rate of change for a given cluster area.

The architecture above was applied to address these challenges, and was implemented using Amazon’s Elastic Compute Cloud (EC2). In this example, the Twitter search API was implemented with the 50 keywords provided by HHS. This resulted in one million tweets per day collected by a single ingesters written in Node.js. These tweets were written to a MongoDB data store. MongoDB was chosen here because of its cloud friendly licensing and scalability, and the fact that it can store JSON objects natively without needing a fixed schema. Inside of the data store, a simple queue was implemented, where the unclassified tweets were written by the ingester.

For the classifiers, the open source statistical package ‘R’ was picked. This choice was also made due to its cloud friendly licensing, and the open source machine learning libraries available. R is one of the oldest open source platforms, and has a rich, mature community of academic, government, and commercial developers creating statistical packages using it. The machine learning package implemented was RTextTools, a machine learning text classification algorithm.

This particular algorithm builds its predictive model via human training – an initial set of tweets were classified by humans as relevant or irrelevant, depending on their context. From this input, the predictive model is then generated, and then new tweets can then be submitted to the algorithm for classification. The initial set of tweets humans classified numbered approximately 4,000, and the effectiveness of the resulting predictive model (effectiveness measured as where the predictive model matches a human made classification) was 82%. Subsequent tunings of the predictive model – adding the tweet inputs to the training set where the human and machine disagreed, and then regenerating the predictive model - resulted in an increase of effectiveness to 88%.

It should also be noted that the R classifiers in this example were set up to classify in real time, as the tweets came in. In this implementation, the classifiers would pull tweets out of the unclassified tweet queue in MongoDB, classify them, and write the results into a classified table. Two classification machines performed the classifications, and in the event the unclassified queue became too long, additional classifiers would be automatically launched by the system monitor to handle the load, and then shut down automatically when the queue was reduced to a user defined threshold. The processor/memory utilization of the classifier was routinely above 90%.

The final two components – the system monitor and the user interface were combined into a single machine for cost purposes. The GUI was a simple PHP application deployed under Apache that gave totals, averages, and did simple alerting when instances of valid tweets spiked. The system monitor machine was a combination of shell scripting, cron, Python libraries, and EC2 API tools.

The solution ran continuously on EC2 for three months during the summer/early fall of 2012.

Costing model for the system:

- Number of tweets collected per day: 1,000,000
- Single Node.js ingester (EC2 micro): $0.02/hr * 24 hrs = $0.48/day
- Two R classification machines (EC2 small): $0.06/hr * 24 hrs * 2 = $2.88/day
- Third classifier needed approximately 20% of the time: $0.28/day
- MongoDB data store (EC2 large): $0.24/hr * 24 hrs = $5.76/day
- System monitor / Apache PHP GUI (EC2 small): $0.06/hr * 24 hrs = $1.44/day

Cost per tweet:

\[
\text{Cost per tweet} = \frac{0.48+2.88+0.28+5.76+1.44}{1,000,000} = 0.00001084 \text{ per tweet}
\]

Many lessons were learned from the implementation, including that social media classification and analysis can be done very economically on a very large data set using the publicly available cloud platforms.

II. Case Study – Using Social Media to Detect the Outbreaks of Food Poisoning

Similar to the above example, the City of Chicago Department of Public Health (DPH) was interested in a more niche application of the outbreak use case: detecting cases of Chicagoans using Twitter to complain to their
social media friends about acquiring food poisoning from public restaurants. If detected, DPH could use these reports to more strategically deploy their restaurant inspectors, as the public generally is not aware they should report acquiring food poisoning to the DPH.

An architecture similar to the above one was implemented, and since the geographic boundaries of this data set were limited to Chicago (using the Twitter bounding box API), a much smaller volume of tweets needed to be processed. Instead of two classifiers pulling from the data store, a single R-based classifier in this case would listen over http for incoming tweets from the ingestor, and classify them in real time. In this architecture, the R-based machine learning classifier is run as a pure service. This allows a single, low volume classifier to serve several classification projects simultaneously. The more open interface also allows other applications to be developed as needed. This real time, open interface can be easily demonstrated:

Tweet: “Ugh! I got food poisoning from the McDonald’s last night!”

The tweet is submitted to the classifier as follows:
http://184.73.52.31/cgi-bin/R/fp_classifier?text=Ugh%20I%20got%20food%20poisoning%20from%20McDonalds%20last%20night

Results: “food poisoning tweet”

Tweet: “U of Chicago releases a new paper on the effects of food poisoning”
http://184.73.52.31/cgi-bin/R/fp_classifier?text=U%20of%20Chicago%20releases%20new%20paper%20on%20the%20effects%20of%20food%20poisoning

Results: “not a food poisoning tweet”

This is because the machine learning model was trained to only accept people talking about acquiring or having food poisoning.

In the event the classifier detects a Chicago Twitter user complaining about food poisoning to his/her peers, the DPH then has the option of reaching out to the Twitter user (via Twitter) to request more information from them, so that a restaurant inspector can be deployed.

The project went live in the spring of 2013, and has been active since. A formal paper was submitted to the United States Center of Disease Control (CDC) outlining the successes of this project. It was peer reviewed, and published in the Morbidity and Mortality Weekly Report (MMWR) in August 2014.

III. Conclusion

Both use cases demonstrate that problems can be detected via people normally interacting with their social media peers, if the relevant problem tweets can be detected accurately. Ubiquitous computing platforms and open source software provide the basis to accomplish this result in a very economical manner. In a similar manner, the above methodologies could be used to find social media users complaining about a company’s products or services. This will not only help manufacturers uncover intermittent issues before they become catastrophic but also save themselves hundreds of millions in recalls and brand damage.

VII. References

[1] https://twitter.com/BizarreTweets/status/2802389575
[3] https://dev.twitter.com/docs
[8] http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6332a1.htm?s_cid=mm6332a1_w

Gadgets & Technology

- The first public cell phone call was made on April 3, 1973 by Martin Cooper.
- The Motorola DynaTAC 8000X was the first cell phone sold in the US; launched on April 11, 1984, it was designed by Rudy Krolopp and weighed 2 pounds.
- There are more than 4 billion cell phones in use. About 3 million cell phones are sold every day.
- Since 2008, video games have outsold movie DVDs.
Challenges of Ubiquitous Computing

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Areas of Interest
Oracle ERP Practice,
Future Technologies in IT
I. Introduction
Ubiquitous computing enhances computer usability by placing devices (computers) in the physical environment to make them effectively invisible to the user. This suggests how the computers after being present everywhere perform invisible actions in order to meet the user’s needs. See Figure 1 for the abstract level of UbiComp environment. One of the examples of Ubiquitous computing is the smartphone-based ECG (ElectroCardioGraphy) monitoring system. The mobile phone technology has a great impact on the development of remote monitoring systems. The Android smartphone-based technology allows ECG sensors to communicate wirelessly with the phone. The smartphones have certain features like computation and storage capacity along with ubiquitous connectivity that enables it for continuous health monitoring.

The primary name behind this innovation is Mark Weiser also known as the Father of Ubiquitous Computing (UC). The article focuses mainly on the challenges in Ubiquitous Computing.

The need of new products and services are the main reasons behind the requirement of Ubiquitous Computing in today’s world. As per the application areas the major benefits can vary such as cost savings, increase in energy efficiency, enhanced comfort, improved safety and improved usability. The major challenges faced in rapid development of Ubiquitous Computing are less efficient human-machine interfaces, the need for data protection, ensuring environment sustainability, minimizing resource consumption and legal regulation.

Now that we have smart devices in daily life, ingredients of one of them can be easily explained here. The common man can then relate to this example.

II. Ingredients of Ubiquitous Computing and Related Challenges

a) Microelectronics

Microelectronics is the study of manufacturing of small electronic designs and components like integrated circuits (IC). The microelectronic devices consist of transistors, capacitors, inductors, diodes and resistors.

The challenge for microelectronic devices is to strive for smaller size, faster speeds, more complexity, higher power and lower cost. The main force behind these is the microprocessors.

Increased circuit density will yield significant gains in functional capacity for a given IC size, but field of microchips is running up against physical limits that are increasingly expensive to overcome.

b) Sensor Technology

Sensors can be called the central or main part of Ubiquitous Computing technology. A sensor is a device that senses events or changes in surroundings which in turn amplifies processes and relays them as a digital signal.

The main challenge in sensor technology is to decrease the size, weight, manufacturing cost, power consumption of sensors. The other challenge is to increase the efficiency of sensors and integration of sensors in complex systems.

In future, the goal is to impose sensor directly onto the integrated chip.

c) Communication Technology

Information and communications technology (ICT) is generally referred to extended version of Information Technology (IT).

ICT plays an important role as the primary
fundamental aspect of Ubiquitous Computing. A growing number of omnipresent computing devices will need strong and resilient communication networks.

- The challenge faced related to Communication technology is the development of IPv6 for address space and mobile IP for mobile communication. Adoption of IPv6 addressing scheme will realize huge addressing pool where each and every device will be able to get its own unique global routable IP (Internet Protocol) address. This will allow more transparency in the network and communication bandwidth will increase.

**d) Localisation Technology**
- Localisation technologies consist of different types of techniques that enable us to locate a person or an object in space. These include mainly satellite positioning systems, video surveillance and wireless transmissions.
- At present Global Positioning System (GPS) is the only global navigation system available. The main challenge in GPS is to increase the outdoor precision of 10 meters and 1 meter indoors. The other challenge is to reduce the equipment size.

**e) Machine-to-Machine communication**
- Machine to Machine (M2M) communication is the technology which allows both wireless and wired systems to communicate with similar type of devices. Ubiquitous Computing needs standardization of machine to machine interfaces as thousands of components interact simultaneously.

Please take a look at Figure 3. It depicts the whole pinpointing logic.

- The major challenge in M2M is the global adoption and deployment of the IPv6 to accommodate the large space required. Another challenge is to provide good graphical and intuitive user interfaces.

**f) Human Machine Interface**
- Human-machine interface deals with human-machine interaction. The examples are rubber keypads and touch screens. The objects of Ubiquitous Computing need very good human-machine interface to interact among them. Figure 4 depicts a visionary future UI where the distinguishing line between Human-Interaction & Computer-Interaction goes on fading, making computers more and more usable for the masses.

**III. Internet of Things (IoT)**

After Cloud and Big Data revolution, a new technological impact has arrived on the scene: Internet of Things (IoT). The meaning of IoT is that it is a world where all objects have the ability to send and receive data over a network without the need of either human-to-human or human-to-computer interaction. Figure 5. depicts analysts and organization's such as Cisco and Intel have predicted that 20-40 billion of devices will be connected to the Internet by 2020.
The major challenges of Internet of Things (IoT) are:

a) IPv6 adoption
- Billions of new IP addresses need to be supplied to billions of devices. IPv6 includes 128 bits, which is 4 times more than 32 bit IP address in IPv4. Although the industry is aware that we will run out of IPv4 addresses soon, IPv6 adoption is not growing as fast as needed. In fact a decline in IPv6 adoption has been observed. Without IPv6, the Internet of Things (IoT) would not be possible as there will not be sufficient supporting infrastructure to sustain that kind of humongous & simultaneous data communication.

b) Data Storage investments
- As the number of devices going online will increase in future, we need to have improved and huge data storage facilities. One of the ways is to have new and large data centers. It is understood that it will require very huge investments.
- The data centers staff will have to control the flow of data and get it to be used as homogenous entity in different places. The companies will have to adopt a selective approach to selecting information that needs to have a backup, a process that could be expensive.

c) Consumer Needs
- The major question is whether do people really need all the devices connected with each other for communication in the future. The people will be reluctant to sell off old gadgets like television, refrigerators because all of them have life of several years. It will be a waste of money if people sell the old gadgets & appliances just for the simple reason of non-IoT compliance.

d) Power Consumption
- Thousands of IoT devices signaling and sending data between one another takes a toll on power and CPU consumption. With all this communication, we need minimal battery drain and low power consumption. Using the smallest amount of energy to make a connection is needed.

e) Bandwidth
- As we have limited bandwidth on cellular network, so bandwidth consumption is one of the major challenges for IoT connectivity. Going ahead, very large servers will be required to handle all the data that will be transmitted on the cellular network with all the IoT devices being inter-connected. It will be required that a lightweight network is developed which can transfer data among

IV. Conclusion

Ubiquitous Computing is already more than a mere technology vision. RFID has reached such a high degree of maturity and is entering more application areas aggressively. Smart phones and mobile applications have paved their way and now new devices such as Apple’s iPhone and the iPads are seriously overcoming the paradigm of the general-purpose computer in favor of small, specialized information appliances becoming an integrated part of our life style. Other technical aspects of Ubiquitous computing however still require more research and development before the expected functionalities are suitable for practical use. Ubiquitous computing has a considerable economic potential, to increase efficiency of human productivity. In my opinion, the Internet of Things is being hyped at this moment by companies who are designing equipment for it. In future, we will see more and highly connected devices, but I feel that growth of adoption will be slow.

References
Lego blocks are a good first step towards building robust mansions.

KPITs’ eNOS works similarly for ECU software.

Various OEMs around the world are at different levels of maturity when it comes to ECU (electronic control unit) software. While adoption of AUTOSAR helps in software standardization, few OEMs may find it a giant leap. This is where KPITs eNOS (Embedded Network Operating System) solutions will help. eNOS is the first step towards ECU software standardization. For OEMs that are not so ECU software matured, can adopt eNOS architecture and then later adopt AUTOSAR. eNOS is simple ECU architecture that has a basic scheduler and it supports CAN and LIN protocol. It mainly has COM, Network Management, SWDL (Bootloader) and Diagnostic Kernel.

Being in the market for a long time, eNOS is stable. Leading car makers in Europe have KPITs eNOS solution in their production program for last 10 years and running.

KPITs’ eNOS on road

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Being Ubiquitous: A boon or bane

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I. Introduction

Ubiquitous computing is the collective term in modern times which associates with technological products being present virtually everywhere in our lives. Computing technology today has come a long way and we can say that based on the multiple aspects in our daily lives which technology has touched. Today we have technology in our homes that controls room temperature and airflow; wristbands that monitor blood pressure and heart beat; wallets that can compute bank transactions; a microwave that can cook food with voice commands; goggles that can direct us to a good restaurant, based on our preferences. Who can negate the smart phone revolution! Smart phone is more than just a communication device. Be it checking emails on the go, booking movie tickets, keeping a track of your health or playing games; thousands of applications are available to suit different needs. Today we have a scenario where clients need their enterprise applications to be available on smartphones/tablets so that they are available 24x7 on the go without the need of accessing their systems (laptops or desktops). Therefore, if a client wants to create sales or a purchase order; or whether a manager wants to approve leave for his subordinates; these activities can be taken care of via mobile-enabled enterprise applications. It’s almost as if we are handing over control of our day-to-day activities to make things easy and systematic for ourselves.

There have been a few demonstrations of futuristic ubiquitous computing as well. To mention a few, a coffee mug with LED indicators that tell us the temperature of the beverage; helmets that can read the mind of the wearer and decide whether he/she is happy driving on a particular stretch. It also informs others about low/high traffic in that area. Most people find these technologies very helpful.

However, all said and done, with the advantages of being ubiquitous, come the potential risks as well. What if the devices or applications we trust so much, malfunction’s or face a malicious attack from hackers? Who knows the software or the free applications or games, which you spend hours playing, is secure and is not sending out secret information from your phone to potential attackers looking to gain access to your private information. Or maybe the companies who are looking for their next big product are accessing your personal phone feeds secretly through the software? Thus, the common threat is lack of privacy. Ubiquitous computing systems have communicators, logic computing and actuators. Imagine if the actuators are vulnerable and allow people to manipulate them?

To give a simple example: let us take the smart coffee mug, which can sense the temperature of the liquid inside it and indicate through the LED indicator. What if the indicator is hacked and it shows the temperature as cold even if the coffee is hot? You would burn your mouth. You might argue that you can see for yourself if the coffee is hot or not, but in the due course of using the smart indicator, we get used to it and blur the natural instincts. This is a very simple problem and the impact is not so dangerous. Now what if, the actuators of a car braking system are hacked? The impact is irreversible.

Thus, security of the devices and applications which control our activities is of prime importance. The very purpose of ubiquitous computing will be destroyed, if the underlying systems used are not secure.

Security Aspects

The fundamental purpose of a secure system is to protect the intended purpose of the system and to provide confidentiality of data that the designated system holds. Few basic concepts being followed to design and maintain secure systems are Authentication, Data integrity and Confidentiality. Concepts like authorization and non-repudiation follow too. Let’s analyze these concepts.

Authentication

The system is designed to confirm that the current user is the right person who is eligible to use the system. This is achieved through a systematic check of digital identity of the legitimate user. A very basic example of digital identity is a user name and password. There are a few other mechanisms of identifying a user through physical tokens/devices, like a mobile phone or digital key like RFID.

![Fig. 1: Example of weak authentication pass-phrase.](image-url)
(Radio Frequency Identification) tags. The system confirms the user’s identity before letting him use the system through one or more of the mentioned means. An insecure authorization is like keeping your front door open for anyone to enter the system and control it, so immense care should be taken while designing the system and while selecting the digital key or access mechanism for the user.

**Data Integrity**

Data processed by the system should not be tampered or manipulated in any manner. Data includes data received and sent via various communication channels and data stored in the system. This can be achieved by validating the data before processing it and avoiding insecure data exposure. There are a few mechanisms available like hash comparison and strong encryption for achieving data integrity. Having a loose end in data integrity will only make the system vulnerable and prone to attacks, allowing the attacker to manipulate data and overall working of the system.

**Confidentiality**

A malicious person’s intent is not always destroying system’s purpose, but he might want to access information, which is highly confidential or enough privileged to do harm. This kind of attack is a passive attack. The data can be used in future for further attacks as a knowledge base for profiling. Data stored or communicated should be strongly encrypted to avoid data exposure. Having strong encryption in every computing system is not always possible because of computing limitations. Encryption algorithms are complex and are intense computing algorithms. The designers should take due care while choosing the encryption algorithms for a better system security.

**Security Failure Examples**

From times immemorial, security breaches have been present. Whether, in ancient times, an enemy spy entering the army to execute an assassination plan; or hacking and decoding of radio messages during World Wars or the very recent Heart bleed security bug, security breaches have advanced in tandem with security advances. Apart from the numerous known attacks, many are still unfound and who knows as you’re reading this, more are in the process of development.

To give you all an idea of how modern attacks are being performed and how they are related to the computers we use in daily lives, here are a few examples:

**Pick Pocking**

A classic pick pocket should have great skills to flick your belongings from your pocket without you noticing. The modern pick pocketing doesn’t even need physical contact to steal all your credit card details. Modern digital cards have RFID embedded in them, which transmit your data when a reader is placed nearby. A thief can pack the reader equipment inside a small bag and roam around in a busy road and the scanner does its job scanning your details. Some smart phones have “Near Field Communication” (NFC) which can also be used to scan RFID used in credit cards. Figure 3 shows a scenario of credit card pick pocketing. This is not limited to credit card details but any security system using RFID.

**Cars Out of Control**

Hackers have demonstrated how they could hack in to your modern car, which is assisted by intelligent computers. They can control the brakes and engine through the CD player. The car systems use both wireless and wired communications for intra-car communication. There may be one system, which is vulnerable, like the CD player, and the attacker tries to send in commands to control other systems like the car braking system.

**Smart Thermostats go Stupid**

Home environment control systems are growing in popularity and attacks on these systems too are coming in to picture. Some of these smart thermostats use the power lines of home to transmit signals. That is a smart
way of utilizing the wiring, which is already in place. The problem with these devices is that they have no encrypted communication. This lets the attackers send their own signals through the power lines and control the whole system.

**Exploitation by Attacker -**

The physical size of computers is shrinking to integrate them into every object we use and finally achieve ubiquitous computing. These computers are becoming very powerful, cheap and more energy efficient. Hackers are now using these mini computers as tools for attacking.

There are many situations where the mobile phones, which are beyond the stereotypical devices of communication, are used for attacking other systems. For example, someone’s credit card can be scanned with a mobile device and then used by that person.

**Fig. 4: Smallest Arduino computer model.**

If you have heard of the Arduino project, these are small computers, which can be smaller than your little finger and can do marvelous things. A size comparison is shown in figure 4. The power consumption of these computers is very minute, so these computers can be left out hidden in any place for days and can continuously perform their attack without any trace of the original attacker.

At Defcon-19, there was a special presentation given by Mr. Dave Kennedy and Mr. Rob Simon. This presentation was about hacking home-automated systems through the power lines using the tiny devices like “Teensy” device, which is as small as the Arduino device, shown in Fig. 4. This device has a similar kind of processor as the modern mobile devices, which makes it powerful.

**A Final Note**

As a closing remark, I would like to say that no matter how much security is built into a system, it is vulnerable and prone to attacks. Being Ubiquitous comes with a price, and although the systems we work on do provide some level of security, it is important for us to be vigilant and alert while interacting with the systems.

Ubiquitous computing systems should be robust and secure. The potential that they bring is enormous, so is the threat. So, my advice, be Ubiquitous, but in a safe way!

**References**

2. Hacking over power lines, speech by Mr. Dave Kennedy and Mr. Rob Simon (Defcon 19 Conference)
8. Gyrophone: Recognizing Speech from Gyroscope Signals by Yan Michalevsky Dan Boneh and Gabi Nakibly
Best Under a Billion

Forbes Asia features KPIT in this list again!

A Tech Company With An Auto Focus.

This story appears in the August 18, 2014 issue of Forbes Asia.

When three guys from an accounting firm in Pune came up with the idea of offering IT services back in the late 1980s, they were entering uncharted territory. Personal computers were still getting popularized, and Indian businesses were new to computers in general. And the trio themselves were having to reorient—but they had an edge. Two were accountants—Ravi Pandit and Kishor Patil—and they were teaming with an in-house tech expert, Shirish Patwardhan. All were part of Pandit’s father’s accounting firm, Kirtane & Pandit, which had a list of well-established clients. So the first 50 or 60 customers for the new IT company, christened KPIT, came from the accounting firm.

“As an accounting company we had long relationships with the same set of customers, which is what we brought to the table in the IT area,” explains Ravi Pandit, the youthful 64-year-old chairman of KPIT Technologies. “When you are getting into a new area you really need clients who will live through your initial bad patch.”

Thus began KPIT’s journey. The company, founded in 1990, soon evolved into one of the fastest-growing IT enterprises in the country. Revenues went from $10 million in 2002 to $100 million in 2007 to $444 million in 2014. Profits have more than tripled to $42 million in the last seven years. This performance has earned it a spot on the Best Under A Billion list for the second straight year.

(Source: Forbes Asia)
Future of Ubiquitous Computing

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Areas of Interest
Data analysis,
Pervasive computing
Future of Ubiquitous Computing

The alarm clock chimes the melodious alarm note and displays the date 1.10.2114. Slowly, as I arise from the many layers of my dreams, I wonder why I have kept that tone as my alarm music. It makes me feel more relaxed than awake. It is a wonderful feeling, getting up so fresh. Buying that smart wrist band was a good decision. It monitors my sleep patterns and automatically integrates with my alarm clock to wake me up.

Need to connect to Mom and Dad for early morning tea! Hey Charli Connect me to Mom. Charli is my efficient man Friday — a 5th generation humanoid robot built specially for giving company and catering to a home’s needs. What would I do without Charli? He reminds me of things that I need to do, assists me in the kitchen, gives me information I need, plays music, and above all gives me a pleasurable company. This reminds me I have to get the chip Charli mentioned me about, as a part of his manufacturer news updates. Embedding it in my neck, I would be able to telepathically communicate with Charli. How cool would that be! But then, I really enjoy the conversation I have with Charli; pushing thoughts without words might not be that much fun. I will postpone the purchase to a later date. Charli meanwhile enters the room.

Charli: Good morning
I: Hey Charli! Good morning. What’s up!
Charli: Sure thing, boss.
Charli then switches on the image projector and patches me to mom’s image projector far away in Tokyo. A word about image projector: it’s just a communication device which has the ability to carry one’s virtual image to another place. It simply does not matter how far the place is, thanks to the ultra-powerful broadband our generation enjoys.

The projector screen flickers and lo! Mom and Dad are just about to start sipping their tea.

I: Good morning
Mom and Dad: Good morning, son! (With their usual bright smile)

Discussion was as usual. The oft-repeated complaint of Dad’s voluble snoring, the non-stop mewing of the neighbour’s cat, the climate, the vegetable rates, the city, Japan, India all in a span of 20 minutes. Information overdose! Exhausted, I bade them good bye and switched off the projector. Charli on seeing my tired face has already started smiling. I ignored him and went to take my bath. Courtesy my room sensor, the solar geyser was already ON and the water was pleasantly warm. While having bath, I had asked Charli to prepare my breakfast. Stepping in to the kitchen, I found out that Charli had already prepared fresh pancakes using the 3-D breakfast device.

But he was still struggling with the cheese omelette as it needs more elaborate preparation using a cooking stove. I asked Charli to stand by and watch me while I prepared it. After preparing, I smugly said to Charli this is how it is done. Knowing that I was trying to get even, he ignored my last comment and went on to prepare coffee.

After having my breakfast, I went to my study and switched ON the image projector once again to connect to the office. The screen flickered and I was in a vast room that projected images of about twelve people. We, the scientists of our company’s research team, were working on a device/ chip through which one can portably connect to the internet anytime, anywhere. In the technology advances which happened as early as 6 years ago, human beings have been able to connect their brains to the internet through a wired device which connects one’s ears to a net port available in the device. Truth be told, when this happened my awe of human endeavour broke
all levels and I actually started crying. For weeks, I started imagining possibilities in a grand soliloquy to the amazement of all around me. I went on speculating so much that Charli thought I have finally lost it and connected without asking me to my psychologist friend. I reprimanded him later, but I am sure he will do the same thing next time a similar situation arises.

Coming back to our device, I was regularly interacting with my colleagues, Anita, Howard and Shinzo. As they were the principal designers, discussing with them becomes essential. After greeting each other, we started our discussion using the augmented reality (A.R.) design board to carry out the actual design work while discussing.

\[Fig 3: A.R. design board.\]

Anita: Hey, Shinzo, looks like you are physically present in the office today. Image Projector not working again?
Shinzo: Very funny! No not that. I need to tell you guys something but before that I would warn you this would make you all super jealous of me.

Knowingly, we did not feign any interest. But such was his excitement, he blurted it out without any notice to our apparent lack of interest.

Shinzo (smiling): I am now the proud owner of LMV-A Hawk- a smart-jet which can fly at a max height of 100 metres from the ground.
All of us: (Unable to restrain ourselves, we cried) what!!
Shinzo by now was grinning and laying bare his entire tooth set.

In the beginning of 21st century, we had started with the concept of the smart cars. Slowly, over the years the smartness increased but with that the number of cars and the resulting pollution level also increased. With the rising affluence and the mass migration of people to the mega-cities the world over, capping pollution levels became a necessity. It didn't help when by 2070, the world had depleted its fossil supply. So, cars had to go. And in their place, scientists and engineers gave us Super-conducting vacuum trains and smart-jets all powered by solar energy. Smart-jet came into picture just 10 years ago. Fearing this would again lead to traffic jam in the high skies, government has prudently banned it to the general public. So my next question to Shinzo was-

I: Shinzo with the government restrictions, how could you get this smart-jet?
Shinzo (smiling ceased abruptly): It's my brother's.

All of us: (In unison) Ha!
I: Yu, your Inspector brother. How come he allowed you to drive while there are driving restrictions to all the civilians?
Shinzo (now almost whispering): He dropped me off.
All of us: (In unison) Ha!
Shinzo (grinning): But I did take you guys for a ride.
Anita: No, you didn't, ask Yu to actually take us for a ride.
I: Okay, time is up. Let’s get to work now. Howard, what do you think the design of device should be?
Howard who was until now silent and looking at Shinzo in a disapproving manner, started the AR design board to show us his design.
The design looked exactly like a wireless Bluetooth headset of yester years.
Anita: That's nice. So, we will be actually using ear nerves to connect to the brain and with the inbuilt Wi-Fi receptor tap into the public broadband network.
Howard: Exactly! I had my doubts about the design though. The looks are not that cool. The idea is to introduce a wearable device which integrates to the user's environment.
Shinzo: Howard, don't you think it's too big. Look, using nanotech we are already designing a chip which will be embedded inside the user's skin. The device which we are building is specifically for people who don't want to go for the chip.
I: Then why should we not use the existing nanotech to reduce the headset into a small button, which a user can easily place inside his/her ear?
Howard (speculating and simultaneously designing): Yup, it looks possible. Let me check.
I: Superb! Let’s meet up after two days to check the progress.

Bidding adieu, we closed our individual projectors to get back to our own work.

I called Charli and ask him what we had for lunch. Charli said we would have a Paneer, tofu mayo sandwich. Superb! I wanted just that. That's the beauty of an intelligent being. Charli has noted my food intake history, analysed the same and thus, recommended me the sandwich. Happily, I started munching my grub and started speculating on how things have changed. I have seen the rise of technology from the smart to super-smart, all in my own lifetime! These days with so much of technology all around us, we are not even aware which technology we use and when. And actually speaking, it does not matter.

Thanks to the pervasiveness of technology, human beings are now able to pay complete attention to the essential and thus create breakthrough products and services in their areas. Much like introduction of cellular phones and internet about 100 years ago, the pervasive technology today has ushered in an era of tremendous prosperity, peace and happiness. Now, unlike in the past, we don’t have any countries fighting with each other as technology has brought us so much nearer that we can actually understand each other’s plight. And with that understanding peace has grown like the most beautiful flower. What I feel is happening now is we are in a state of continuous flux- a state of evolution. May be the challenges now are different than which we had before and would be very different compared to what our ancestors faced. Whatever the case may be, human beings have kept on marching to the trumpet and tune of technology and innovation and have created a better place for themselves. Hope they still continue in their onward march!

Loud opera music in my ears! I came out of my reverie with a start. No surprise for me, the singer was none other than my very own Luciano Pavarotti, Charli. I could see an extra-large grin on Charli’s video display. I see Charli these days is taking extra delight in pulling my leg. Going to the study, I started mulling on what would be my next trick to stump Charli to his wit’s end.

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**Search Engines, Internet and Energy**

- Amazon now sells more e-books than printed books.
- About 1.8 billion people connect to the Internet, only 450 million of them speak English.
- Google indexed it’s 1 trillionth unique URL on July 25, 2008. That is thought to be about 20% of all the pages on the Internet but a high percentage of the World Wide Web (the public Internet).
- One Google search produces about 0.2g of CO2. But since you hardly get an answer from one search, a typical search session produces about the same amount of CO2 as does boiling a tea kettle.
- Google handles about 1 billion search queries per day, releasing some 200 tons of CO2 per day.
- The average US household uses 10.6 megawatt-hours (MWh) electricity per year.
- Google uses an estimated 15 billion kWh of electricity per year, more than most countries. However, Google generates a lot of their own power with their solar panels.
About KPIT Technologies Limited
KPIT a trusted global IT consulting & product engineering partner focused on co-innovating domain intensive technology solutions. We help customers globalize their process and systems efficiently through a unique blend of domain-intensive technology and process expertise. As leaders in our space, we are singularly focused on co-creating technology products and solutions to help our customers become efficient, integrated, and innovative manufacturing enterprises. We have filed for 51 patents in the areas of Automotive Technology, Hybrid Vehicles, High Performance Computing, Driver Safety Systems, Battery Management System, and Semiconductors.

About CREST
Center for Research in Engineering Sciences and Technology (CREST) is focused on innovation, technology, research and development in emerging technologies. Our vision is to build KPIT as the global leader in selected technologies of interest, to enable free exchange of ideas, and to create an atmosphere of innovation throughout the company. CREST is recognized and approved R & D Center by the Dept. of Scientific and Industrial Research, India. This journal is an endeavor to bring you the latest in scientific research and technology.

Invitation to Write Articles
Our forthcoming issue to be released in January 2015 will be based on “Advances in Transportation Management”. We invite you to share your knowledge by contributing to this journal.

Format of the Articles
Your original articles should be based on the central theme of “Advances in Transportation Management”. The length of the articles should be between 1200 to 1500 words. Appropriate references should be included at the end of the articles. All the pictures should be from public domain and of high resolution. Please include a brief write-up and a photograph of yourself along with the article. The last date for submission of articles for the next issue is November 14, 2014.

To send in your contributions, please write to crest@kpit.com.

To know more about us, log on to www.kpit.com.
The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

Mark Weiser
(July 23, 1952- April 27, 1999)