Wearable Computing and its Application

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Abstract— **wearable technology offers many opportunities which trigger the thoughts and imaginations of people of all fields. In this age of technology, the dependence on computers and other interfaces required them to be omnipresent. This requirement paved way for the development of wearable technology, computers which can assist specialized professionals in personal activities by aiding and augmenting everyday life with the tech savvy world. In reality obstacles imposed by factors such as battery life, processor power, display brightness, network coverage and form factor have led to the delay in the widespread introduction of wearable computers. However in the past 10 yrs many successful implementations and the continuous relentless effort to miniaturize computers promise the emergence of viable applications.**
In this paper wearable computing applications are reviewed from the early aircraft maintenance and military designs to current production models including designs for personal entertainment, communication and health monitoring. This paper also highlights the scope and market of wearable technology in India and the way in which it can bring revolutionary changes in our country.
The hurdles presented by these applications are identified and discussed.

Keywords— **wearable computing; augmented reality; agents; industry; military; medical; health; fashion; games**

1. INTRODUCTION

The terms "**wearable technology**", "**wearable devices**", and "**wearables**" all refer to electronic technologies or computers that are incorporated into items of clothing and accessories which can comfortably be worn on the body. These wearable devices can perform many of the same computing tasks as mobile phones and laptop computers; however, in some cases, wearable technology can outperform these hand-held devices entirely. Wearable technology tends to be more sophisticated than hand-held technology on the market today because it can provide sensory and scanning features not typically seen in mobile and laptop devices, such as biofeedback and tracking of physiological function [6].
Wearable computing facilitates a new form of interaction between the human and the computer comprising a small body worn computer that is always accessible and ready for use. A wearable computer used for such operations is incorporated into the personal space of the user, control by the user and is always on and accessible. For a layman, it is like becoming a 'Superhero', where you can be at more than one place at the same time [22]. A wearable computer is more than just a wrist watch or regular eyeglass, rather it functions just like a computer system. The fact that segregates wearable devices from wearable computer is that unlike those other wearable devices that are not programmable; the wearable computer is as reconfigurable as the familiar desktop

[1].These computers contrary to their size can perform, if not more than equal number of computations as any PC or laptop [4].
The above mentioned definition of wearable computing requires six tests that products must pass to be considered within the scope of this research.
Test1-Wearable - these computers should be wearable for extended time periods with the user experience being significantly enhanced.
Test 2-Smart-they should have advanced circuitry, wireless connectivity and at least a minimum level of independent processing capability.
Test 3-Should provide constant access to information services. They are designed for everyday use and should interact with the user at any given time interrupting when necessary.
Test 4-Wearables should sense the user's internal state and should provide the best cognitive support.
Test 5- They should take minimal necessary attention of the user and should guarantee the privacy and encourage personalization.
Test6- Wearables should mediate between automation or computation in the environment and the user to present a interface consistent with the user's preference and abilities.

Features of Wearable Computer:

The salient features in this novel interaction between human and computer which make it outstanding are :
Consistency: The computer runs continuously and is user friendly. Unlike, a hand held devise like tablets or laptops, it does not need to be opened up and turned on prior to its use. The signal flows from human to computer and computer to human continuously to provide a constant user interface.
Enhancement: Traditional computing archetypes are based on the notions that computing is the primary task. On the contrary, wearable computing does not follow the above notion. The assumption of the wearable computing is that the user will be doing something else along with computing.
Thus, the computer should serve to increment the intellect or augment the senses.
Mediation: Wearable computing unlike traditional computing acts as a mediator as it aids its users by providing its umpteen applications in medical care, domestic use, corporate world, military etc.
Privacy: Wearable computing can be used to create a new level of privacy because it is much more personal as it is worn so it helps to develop a close synergy between human and computers.
Convenient: Wearable technology is of utmost convenience to the user as the right person can use it at the right time and at the right place which offers a great comfort zone and helps to increase its overall utility.
Unrestrictive: Wearable devices enable a person to do multi tasking and do not restrict the focus of a person to one particular thing. For example to access a data on a PDA (Public Digital Assistant), the user must interrupt what he is doing and then focus on the devise. This restricts the activities of the user unlike in the case of wearable computing.

2. APPLICATION

The implication and uses of wearable technology have a widespread impact and influence the fields of medical care, fitness, aging, disabilities, education, transportation, enterprise, finance, gaming and music. The final aim of wearable technologies in each of these fields will be to efficiently incorporate functional, portable electronic and computers into individuals' daily lives. Prior to their presence in the consumer market, wearable devices were primarily used in the field of military technology and had the biggest implications for healthcare and medicine.

Application	Product categories	
Healthcare And Medical	Blood pressure Monitors ContinuousGlucose Monitoring Defibrillators Drug Delivery Product ECG Monitoring Hearing Aids	Insulin pumps Smart Glasses Patches PERS Pulse Oximetry
Fitness and Wellness	Activity Monitors Emotional Measurement Fitness &Heart rate Monitors Food Pods & Pedometers Heads-up Displays	Sleep Sensors Smart Glasses Smart Clothing Smart Watches Other, Audio Ear buds
Infotainment	Bluetooth Headsets Head–up Displays Imaging Products Smart Glasses Smart Watches	
Military	Hand-Worn Terminals Head-up Display Smart Clothing	
Industrial	Hand-Worn Terminals Head-up Display Smart Clothing Smart Glasses	

Table 1: Applications of wearable computing

1. Augmented memory: The Remembrance Agents (RAs) are wearable that continuously reminds the wearer of potentially relevant information based on the wearer's current physical and virtual context. RAs are always on and always active and working, instead of being 'worker up' when needed.

2. Finger Tracking: This is one of the simplest applications of camera based wearable computing. The computer would be able to visually track the user's finger. The user would then be able to control the computer with his fingers as well as he would with a mouse.

3. Face Recognition: Working together with an appropriate face finding software, face recognition system can be adapted for use in wearable computing. Market users include the police, politicians, teachers, the visually challenged and those with bad memories.

4. Visual Filter: This is particularly useful for the visually disabled. The wearable computer can digitally magnify an image or a prose through the use of a virtual fish eye lens to assist in reading. This can be done through the use of a digital visual filter.

5. Navigation: Navigation 8 connecting a Global Positioning System (GPS) to wearable and certain mapping software allows the users to track their desired or the current location while exploring a new city. A visually impaired person might be able to receive warnings of approaching object and hence promote safety in their daily lives.

6. Repair Instruction: By putting as little as 3 exclusive marks at fixed distances from each other, a wearable camera with known focal length can recover the 3-D location of an object defined by these three marks. The wearable automatically determines the hazard, locates the 3D position of the object and prepares specific 3D real time step by step guidelines on the object for the technician to follow.

7. Communication Management: A WAC can be used to manage personal communications naturally with much mobility. Speech recognition can be used to convert the user's responses (with constraints on vocabulary and grammar) into text for email responses. This, in turn, combines speech recognition, synthesis and digital audio recording to act as a virtual secretary which manages mobile communications.

8. Remote Sensing and Maintenance: wearable can provide field workers by giving them remote assistance and expertise through digital data, audio and image. With this, even non expert maintenance personal can accomplish simple repairing tasks with aid of remote experts at the help desk.

9. Industrial: The quick and accurate availability of complex information to the workers in the field, office workplace or in a non office workplace has been important to many organizations since the establishment of computerized records in the 1950s. Many workers need to use one or both hands while carrying out their tasks, and also need to maintain eye contact with taking into account the protection aspect. Depending upon the type of industry, wearable computers have varied advantages. Wearable Computers, because of their flexibility, portability and hands free use, are being used by workers in many types of industries. The wearable computer with a hands free interface, e.g. speech, and a head-mounted display can provide a solution for these workers.

The first organization to recognize this, and to commit resources to researching possibilities, was The Boeing Company. In the 1990's Boeing employed several hundred staff to assemble wiring harnesses for aircraft. These wire bundles were constructed using pegs in a number of 3' x 8' easel-like form boards with paper printouts glued to their surfaces, and a separate set of printouts for reference. It was proposed that a worker with a head-mounted augmented reality display could be guided through the assembly task with no need for reference to paper print-outs. It demonstrated that such a system was practical and identified limitations which would be addressed as technology improves. Worker issues such as safety, comfort and social compatibility needed special consideration.

Another example is the Mercedes-Benz pebble smart watch(Fig 1). The idea is that drivers use the sleekly styled smart watch to check on their vehicle's location, door lock status and even fuel level. The nifty watch can alert its wearer of incoming calls, texts and emails, so too can it in theory warn the driver of real-time hazards when behind the wheel.

Fig 1: Mercedes-Benz pebble smart watch (http://www.digitalspy.co.uk/)

10.Military: The potential applications of wearable computers to an infantryman were quickly recognized by organizations and other law agencies.

Apart from providing command/control communication and navigation functions, a wearable could give access to tactical information that could help distinguishing between friendly and hostile forces, and potentially offering strategies for dealing with dangerous scenarios. Wearable computers will help infantryman use digitally distributed orders, maps, and intelligence. Wireless technology enables each soldier to communicate seamlessly with his comrades within a networked unit.

Eventually soldiers would have the capability to exchange video of what they see with each other via miniature cameras interfaced with lightweight wearable computers. Wearable for military would have to be more rugged and robust to withstand knocks and shocks.

Many military wearable computers are designed with the total integration of man and system in mind.

Much of the research of wearable in military has been kept confidential however examples of collaboration with non-military researchers can be found in the United States, Australia, the United Kingdom and Singapore.

The U.S. Army in particular have funded the Land Warrior program which initially provided positioning and targeting information, battlefield communications, and thermal sight imaging from the soldier's weapon.


Fig 2: Military wearable
(http://www.militaryaerospace.com/)
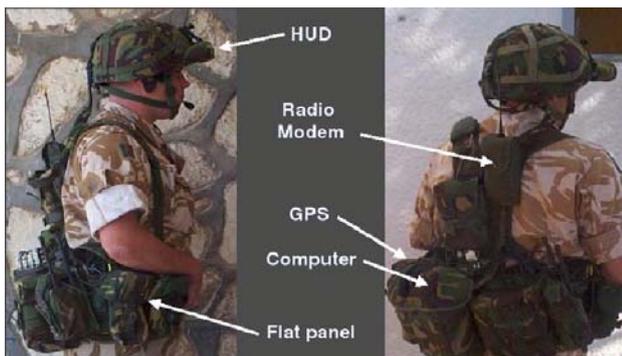
The 9Solutions IPCS is a wireless Bluetooth and SaaS-based real-time locating system (RTLS) and provides a platform which enables real-time identification of people and equipment.

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11. Medical: The knowledge of where the user is located clearly provides the basis for many wearable designs. Wearables can also be designed to monitor well-being and activity -the how and what of the user. This form of context sensing has been put to use in wearable computers for medical and health applications and has met with more success than in any other field. The most common is the pacemaker. However it is not user controllable and hence not considered a wearable computer.

Examples of treatment by a wearable are insulin pump therapy for diabetics and a brain implant to facilitate communication with speech-incapable patients.
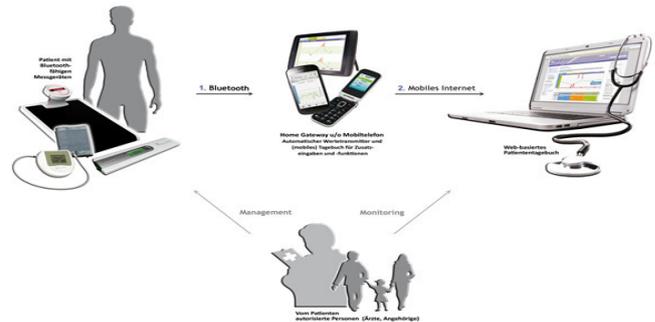
Fig 3: Health monitoring (http://www.embs.org/)

More recently health monitoring wearables have become commercially available in the form of the Body media product range (Bodymedia). They are based around an armband design with sensors for detecting movement, heat flux, skin temperature, near-body temperature, and galvanic skin response. Data can be either viewed in real time via a wireless link, or downloaded for analysis using the Internet.

Many systems have been explored to provide the visually impaired with guidance. Early examples of this were developed at the University of California, Santa Barbara using GPS.

The Metria Wearable Sensor is an entirely new tool aimed at assisting the healthcare industry shift toward prevention. The user attaches the wearable sensor, which uses "skin-friendly" cohesive; the sensor collects data, such as the breaths per minute and number of hours slept and breaths per minute.

The Remote Monitoring System (RMS) system was developed in collaboration with Mayo Clinic and uses designs to support remote monitoring for patients with cardiac problems. Examples include the Electroencephalography (EEG), BodyTel Products and BioMan t-shirt.

12. Sports and Fitness: Interest in wearables has so far been largely driven by consumer interest in sports and fitness. The typical functions of such wearables are performance monitoring, activity tracking, goal monitoring and management, direction data and location share and optimum performance management.

The BioHarness is one such wearable and is an exclusive compact analysis of monitoring module that enables the transmission and capture of physiological data on the wearer via mobile and fixed data networks enabling genuine remote monitoring of human performance and condition in the real world.

Another example are the Smart Training Shoes(Fig 4) which are the next generation of athletic shoes will feature radio frequency identification tags, motion sensors and accelerometers that will allow you to customize the look, fit and responsiveness of your kicks.

Also an activity tracker is a device or application for monitoring and tracking fitness-related metrics such as distance walked or run, calorie consumption, and in some cases heartbeat and quality of sleep

Fig 4: Nike Smart Training Shoes (https://www.google.co.in/)

13. Tourism: A few wearable computers which are promising for tourists and might prove to be a boom for the tourism industry are given below:

Narrative clip: It is a small wearable life logging camera that pins to the chest (or wherever). It records 2 photos a minute. Users can set this to a faster setting if they like, providing a clear record of life lived.

Tourist diary: Tourist diary is to help a tourist organize his trip experience by multimodal interaction. A tourist can request the system to take picture or video clip which he can add or dictate to his diary Tourist Diary" is to help him organize his/her diary. After the tourist if finished the site he could ask the system to generate an html document based on the stored info which he can then share with others.

Triposo travel belt: To help a tourist find their destinations without having to look in their phone every time, Triposo is making a belt called the Travel Belt. It feeds explorers, with up-to-date information, maps, intelligent recommendations, tips and tricks, etc.

3. ADVANTAGE

Consistent: There is always a constant interaction between the computer and the user and hence there is no need to turn it on or off.

Multi-Tasking: Wearable computer provides computational support even when the user's hands, voice, eyes, or attention is actively engaged with the physical environment. Other than its very efficient partaking in recognizing a person in a high alerted area, it can be manipulated to complete daily tasks of the wearer tracking his/her daily habits.

Mobile: Wearable computers must go where the wearer goes. They are always on and their wearer can access the many time. Adding to our convenience, wearable computing enables a person to work from anywhere, literally.

Unrestrictive: When using it you can do other things.

Communicative: It can be used as a communications medium when you want it to. Any person in possession of these devices can communicate with their enterprise information systems without suspending his/ her routine work.

Can't be lost easily: A personal wearable device adheres to the wearer's needs and is very unlikely to get lost also it being embedded to one's clothes as opposed to the handheld devices.

Attentive: Wearable computer is environmentally aware, multimodal, and multisensory. These devices are relentlessly acting out contextual tasks of providing prompts or reminders, apprehending experiences or information and salvaging time-sensitive information in support of the user.

No distraction : Wearable computer does not cut you off from the outside world such as a virtual reality game or the like.

4. DISADVANTAGE

Expensive: Wearable computers are one of the most cultured pieces of technology existing today. Sophistication comes with expense as it requires high levels of technology to come up with wearable computers making the end product high priced and extravagant to many. In the case of a construction company, wearable computers have the potential to increase overall efficacy but are undermined by the high costs of setting up local area networks, LANS, which would aid in the synchronization of data.

Heavy: Wearable computers can be quite heavy. This is due to the many components of the wearable technology that has to be attached to the body. A wearable computer, like any other computer, requires a Central Processing unit (CPU) as well as peripheral devices and a monitor that enable the computer to gasp the input of data. These components are hefty and difficult to wear so it causes enormous amount of problem to the user. The computer can also be quite heavy if all these components are built into the wearable computer.

Discomfort: Wearable computers tend to irritate the user at the time of hot and humid weather conditions as these wearable components emit heat despite the cooling technology inbuilt in them. It also results in health hazards such as headache and dizziness.

Security: If left unattended, wearable technology can cause several security issues as it can be hacked easily. Wearable computers are connected to the company's server to enable easy flow of communication between people out in the field and their counterparts in the office. However, if not tackled carefully, then the outer source can use this information to either steal company or personal secrets.

5. WEARABLE IN INDIA

In a country like India which has various social, economical, cultural, geographical, climatic and political diversities, wearable computing has immense scope and has large umbrella of applications under its fold. It has a considerable market niche and can make a mass appeal to attract a huge number of customers due its wide range of applications.

[1]. Wearables can be extremely beneficial in villages where majority of the people are uneducated .these people are often victims of debauchery and trickery. Wearables can provide them easy access to relevant information at the required time and hence educate them about the situation. Also farmers can require info about their crops and land leading to increase in yield and hence income which might be reflected in the nations GDP in urban areas such wearables can help in reduction of time and effort while processing transactions.

[2]. Wearables can also help in the improvement of health by not only monitoring the health aspects of a person but also reducing the need to frequently visit the doctor. This is of special importance to people living in the remote areas since it reduces the cost and expenditure and also reduces the severity of transport requirement. Also old people can benefit from it by being under constant care since the wearables can be made to transmit information of the patient's health to their doctors. By improving preventive care and giving residential monitoring it is possible to decrease readmission rates to improve patient outcomes and decrease mortality rate.

[3]. Safety in India has been a rising concern. Several wearables are available that could be used to communicate and provide location information of the user. This is particularly useful for women safety who when in danger can inform her near ones and hence call help. Parents leaving their children in daycare can constantly monitor their activity and be sure of their well being. Location providing wearables in combination with health monitoring ones are also used by animal explorers by providing information about the animal's health and activities irrespective of the conditions.

[4]. A wide range of sports and games are played in India. But not all are equally preferred mainly due to the lack of facilities. Wearables can improve the condition by providing stylish yet simplistic and light gears to wear. This will attract the attention of people who might play the sport just for the fun of using them. Also wearables provide a better sports experience by constantly monitoring the sportsman and providing other recreational facilities. These wearables may be particularly useful for Professional athletes, Recreational Fitness Consumers, Clinical and Military research, Corporate Wellness programs, and Chronic Disease management.

[5]. Indian industries may experience a boon in production by using wearables which will help in easier and better manufacturing processes besides also providing safety and comfort.

Industrial applications of Wearable Technology include the use of heads-up displays in production lines, hand-worn terminals in logistics and warehousing and smart clothing to track user location and detect industrial gases.

6. FUTURE AND MARKET SCOPE

We're in a fascinating period when it comes to wearable computers where in both small startups and big-name firms are working on experimentation to tap new markets and convince people to buy the new technologies which could be of immense help to them.

The aim of wearable computing is to design wearables that are either very stylish or invisible. In today's fast moving world besieged with technology all around, there is immense marketplace in a huge country like India.

The need of the hour is to make people aware of the new technologies that are surging in the markets.

For instance, a lot of wearable devices have come up in the market so that the fruits of development may reach out to people which includes Apple testing iWatch, iRing, S6 Golf Watch, Wrist Gear, Sony Smart Band, 3 High-Tech Eye Glasses, Google Glass, Bluetooth Ring, iPhone-Connected Jewelry with wireless security alerts, Smart contact lenses for medical purposes, Smart Eyelashes and Fingernails etc.

7. CONCLUSION

Wearable computing enables significant new research opportunities in interface, artificial intelligence, and perception. As research into perception and user modeling through devices carried on the body progresses, new intelligent interfaces will result that will reduce work and complexity and lead to new capabilities. However, by simply making eye catching and lucrative wearable technology will not serve the purpose until it reaches out to the massive population and their full market potential is tapped.

ACKNOWLEDGEMENT

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