

Evaluation of Ubiquitous Mobile Computing and Quality of Life in Wearable Technology

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Abstract: Science improves the quality of your life in many ways through application in technology. Technology is used everywhere and enriches our lives by making things more entertaining, convenient, and easy. In the past decade the gradual emergence of information technology as a new computing discipline has impacted on the *Quality of life* (QOL). QOL references the general well-being of individuals and societies. As computing moves from our desktops to our phones, we are looking into the future to see how technology will become increasingly ingrained in our movements and our active lives. They have the possibility to make us more knowledgeable about ourselves and our surroundings, and connect us with each other in an uninterrupted, more intimate way. The many promising prospects of Wearable technology and its applications have not perfectly materialized, and research into their effectiveness in QOL has left many unanswered questions. A finding from this paper has indicated positive effects and consequently a need for more in-depth and longitudinal research into the impact of wearable technology on ubiquitous mobile Computing.

Keywords: QOL, wearable technology, Mobile, Ubiquitous computing, CES

1. Introduction

Wearable technology ,wearable devices, techs togs or fashion electronics are clothing and accessories incorporating computers and advance electronics technologies, The designs often incorporate practical functions and features but may be purely critical or aesthetic agenda. “ How do you balance fashion and function? ” (Fitbit Gadi 2008). Wearable Technology comprises all technical end devices in the form of clothing and accessories. The central function is the recording and processing of data related to its user. Wearable technology is related to both the field of ubiquitous computing , with ubiquitous computing wearable technology share the vision of interweaving technology to the everyday life of making technology pervasive and interaction frictionless (www.wikipedia.com). Computing has moved from our desktops to our phones,ipads and tablets, we look into the future to see how technology will become increasingly ingrained in our movements and our active lives. From the Nike Fuelband to Google Glass, consumers are already seeing hints of the future of wearable devices. They have the possibility to make us more knowledgeable about ourselves and our surroundings, and connect us with each other in an uninterrupted, more intimate way. From Do It Yourself wearables to high-tech sensors and smart

fabrics, the years ahead will show how integrated technology can impact our lives for the better. Wearable technology has become a buzzword in 2014, so much that it is ultimately becoming a yardstick for technology companies to prove that they are still relevant, many experts claim that wearable's are the biggest thing since the Smartphone. The tech companies are coming up with tantalizing offers to gain market share. So the question is wearable devices here to stay?.

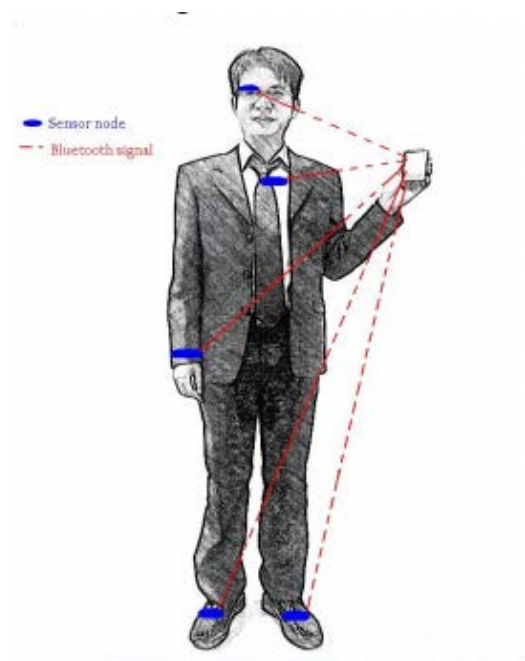


Fig 1 Body sensor network connecting to mobile phone device

Users can install APPs to their mobile phones to display medical data in an easy-to-digest format. Furthermore, users can use the APPs to transmit the data to the server of remote medical care systems or cloud computing environments to have more accurate diagnosis as shown in Fig1. (© Andes Technology Corporation). According

to international consumer electronics show (CES 2014), a global electronics and technology trade show in Las Vegas USA, wearable tech devices fall in three major Categories.

1.1 Smart watches

These are wrist –worn devices that take up the form factor of a watch, but give you more than just the time. The basic idea is that these watches pair up with your phone to notify you when you get emails , texts and so on, without you having to pull your phone out of your pocket or handbag, Some variants have extra functionality like taking photos, GPS location activity monitoring as well as apps- like Mercedes app on the pebble smart watch that tells you how much fuel you have or tyre pressure even if you are away from the car. The major devices in this field are Samsung’s smart gear, Sony’s smart watch and pebbles smart watch and apple smart watch. The beauty with smart watches is that they are less obtrusive way of notifying you of what’s going on in your personal cyberspace, but since they may have to be linked to your phone to give you full functionality; many experts term them a rather expensive accessory with very basic autonomous functions. Some argue that they are clunky and unfashionable. With the regular watch being the last socially acceptable piece of jewellery for men and women, the technology still needs to jump over acceptability hurdle to become more mainstream. Tech companies are aware of this and there are collaborating with fashion houses like burberry and Ray bay to give their devices that final attractiveness

1.2 Trackers (Activity monitors)

Trackers (Activity Monitors) The second major category in the wearable tech realm are the fitness trackers or activity monitors. This second variant is mostly worn on your wrists but is not limited to this. Some are full body wearable's, like in the case of Intel's Mimo baby monitor, while others are in ear or are worn as headgear. The core functionality of these trackers is to monitor your body's essentials — heart rate, blood pressure, concentration levels and the like. They prompt you to take action, like increase your level of exercise or even go and see a doctor.

Some trackers monitor your heart rate and couple it with a special algorithm to give you information about how well you are sleeping. The main appeal of these devices is that they give you personal data on the go, making you more aware of what's going on with your body and what you need to do to correct any imbalances for optimal function. With the current speed life moves these days, we really can't take such service for granted since we hardly have time to listen to our bodies (Jawbone, Fitbit, Mimo Basis , LG).

1.3 Glasses

The last major category of wearable tech is glasses, though the idea is still at its infancy. These are worn on the face and have a wide range of function — from taking pictures and recording videos to playing music. The glasses record your everyday life as you are living it, and let you share it. In tandem with various apps, they also give you up-to-the-minute information about what's in front of

you. For instance, the camera can spot a landmark and give you information on its history, or use facial recognition and draw up someone's facebook or LinkedIn profiles. This would give you that extra edge of information during a presentation or even during a chat in the club, streets, when you meet someone who's name you don't immediately recall. And you know how bar arguments end after you utter the words, "Let's Google it"? Now this will be possible at the blink of an eye. The major offerings in this category are Google Glass, Epson's Moverio and GlassUp by an Italian firm of the same name.

2. Technologies behind Wearable technologies

- a) Automatic speech recognition: Recognizers can either process isolated- word speech requiring the user to pose after every word, or can deal with continuous speech
Keyword spotting is the process of detecting specific words or phrases in a stream of speech (Bakay and Kennedy, 1999).
- b) Structured Audio : This structure provides “ handles “ into the recording which can help the user efficiently access to contents . Rather than providing indices at arbitrary locations in the recording (for example at equal time intervals in a CD players) access may be improved by finding events of interest in the audio recording
- c) Speech synthesis: speech synthesis is flexible since arbitrary prompts may be generated at run time by an application.

3. Design, Architecture and Interfaces

Each of the above mentioned applications requires a unique set of hardware components. They do, however, have a couple of definite common requirements. It is critical that the hardware be compact, streamlined, lightweight and energy efficient. Possibly the most important design requirement is that the user interface be easy to use, ergonomically suitable, and application appropriate. Many of this device centrally to popular belief can be implemented technology that is currently available. For instance, existing hardware allows for the entire American Sign language Recognition system embedded unobtrusively into a cap, as a wearable device. A match-stick sized Camera, such as the Elmo-QN401E can be set in the front seam above the brim, and the brim can be made into a reasonably good quality speaker by lining it with a PVDF transducer and a 104 based CPU, digitizer and batteries can be placed at the back of the head. A system with these components could perform highly accurate ASL recognition using Hidden Markov models without conspicuous.

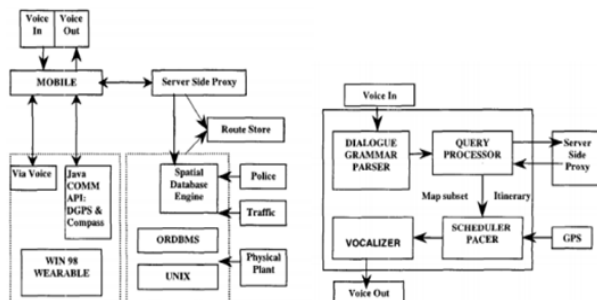


Fig 2: An Integrated Navigation System for Visually Impaired and Disabled. (Source:

IEEE – Wearable Computers, 20001. Proceedings)

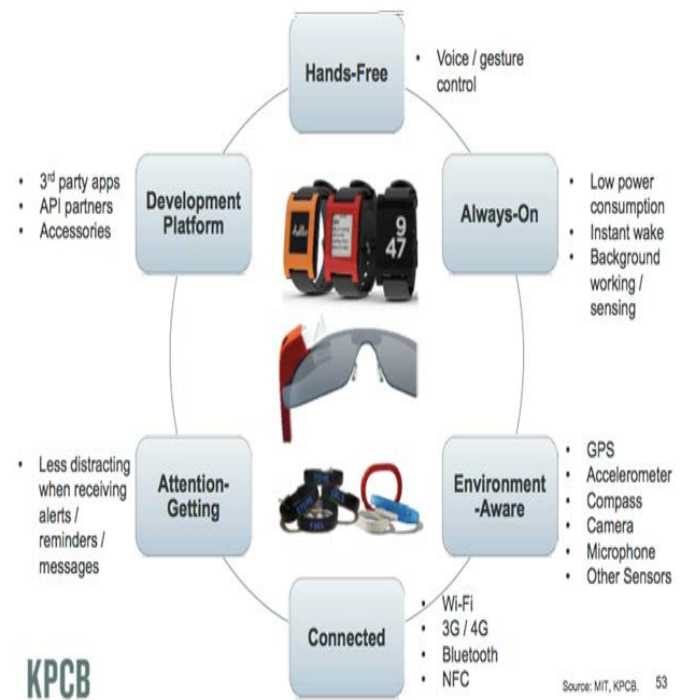


Fig 3: Wearable Technologies Attributes (source MIT KPCB)

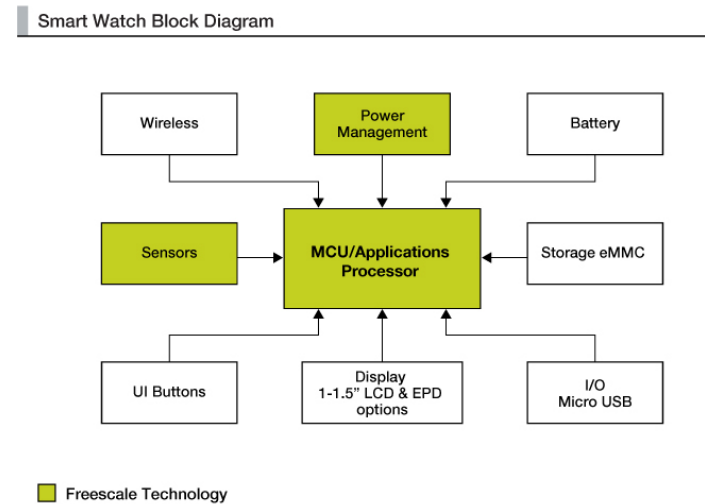


Fig 4: Smart watch Block Diagram (source <http://www.freescale.com>)

Smart watches are connected platforms used for interacting with smart phones and potentially other connected devices to complete a variety of tasks, from retrieving

SMS messages and emails to streaming music and screening calls . It's a new product category that is redefining how wearable technology can be used, and new usage models are rapidly being developed. With a broad portfolio of embedded solutions, from ultra-low-power Kinetis L series based on ARM® Cortex-M0+ technology to i.MX 6SoloLite applications processors based on ARM Cortex-A9 technology, as well as a broad range of lightweight yet feature-rich software options, Freescale technology enables current and future usage models for the smart watch as seen in fig 4.

4. Methods and Findings

The study was done using Secondary data from YouGov © Statista 2014, including email and internet surveys. According to a new market research report "Wearable Electronics Market and Technology Analysis (2013 - 2018): By Components (Sensors, Battery, Display, Networking); Applications (Consumer, Healthcare, Enterprise); Products (Smart -Textiles, Glasses, Watches);e-Materials and Geography" published by Markets and Markets (www.marketsandmarkets.com), the global wearable electronics market revenue is expected to cross \$8 billion, and the total unit shipment is expected to cross 130 million units globally, by 2018.

Wearable device market value from 2010 to 2018 (in million U.S. dollars)

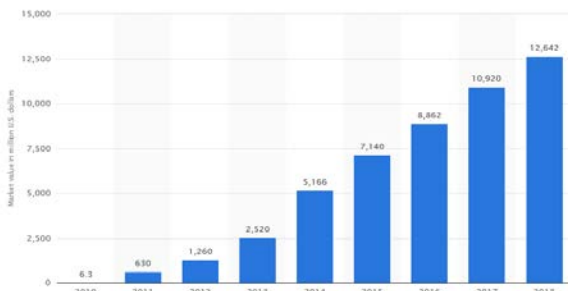


Fig 5: wearable device market value from 2010 to 2018.(Source - © Statista 2014)

The statistic in fig 5 provides a forecast for the market value of the wearable device market from 2010 to 2018. Wearable technology in the future is expected to include products such as Google Glass and the iWatch as well as other medical technology. By 2018, it is estimated that this market will be worth some 12.6 billion U.S. dollars.

Would you consider buying and wearing Google Glasses?

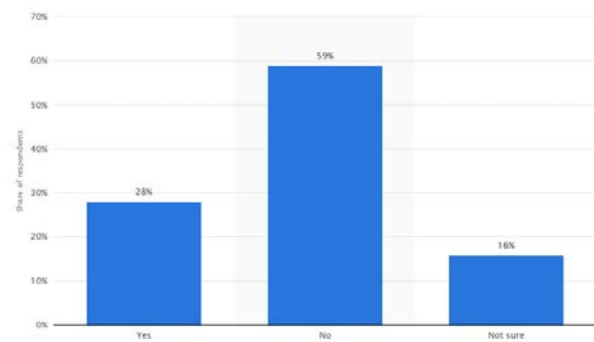


Fig 6: shows the percentage of people who would consider wearing a google glass

(Source: YouGov © Statista 2014). A survey conducted in May 2013, consumers were asked if they would consider buying and wearing Google Glasses upon their official release. 24 percent of respondents said that they would at least consider it (fig 6).

Would you feel comfortable interacting with someone wearing Google Glasses?

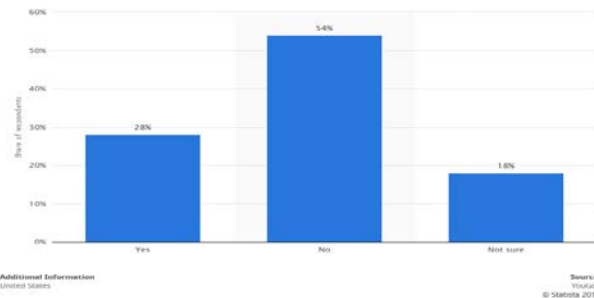


Fig 7: Shows the comfort interactivity of Google glass.

A survey conducted in May 2013, consumers were asked if they would feel comfortable interacting with someone wearing Google Glasses. 54 percent of respondents said that they would not feel comfortable. See fig 7.

Top five form factors that mobile developers worldwide predicted they would build apps for in 2015 (as of 2012)

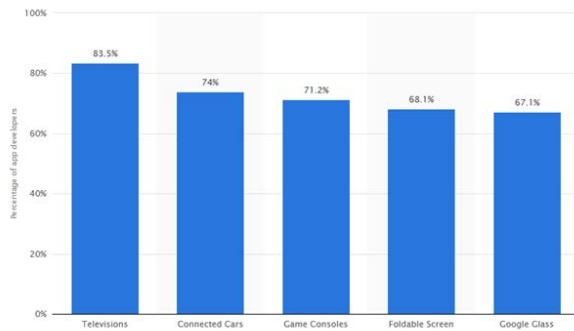


Fig 8: Shows factors that mobile developers worldwide predicted they would build apps in 2015

(Source: international data Corporation ,Appcelarator)

The statistics in fig 8 shows the top five form factors that mobile app developers worldwide in 2012 predicted they would build apps for in 2015. The statistic shows that 83.5 percent of developers predicted they would build apps for television, and 67.1 percent predicted they would be building apps for Google Glass in 2015.

Google Glass annual sales forecast from 2014 to 2018

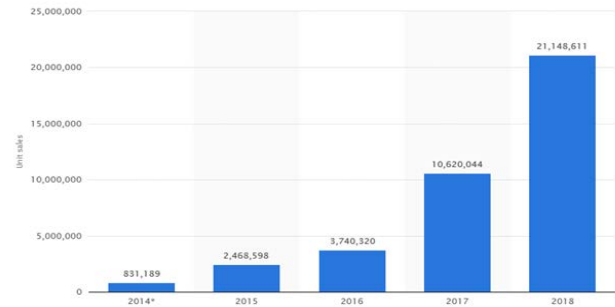


Fig 9: Google glass sales forecast from 2014 to 2018 (Source:Business Insider © Statista 2014)

In the fig 9 we can see a forecast for the sale of Google Glasses from 2014 to 2018. The source predicts that Google's product will sell well and that by 2018 will sell more than 21 million units.

How likely is it that you will buy a new Apple iWatch for yourself or someone else if and when it becomes available?

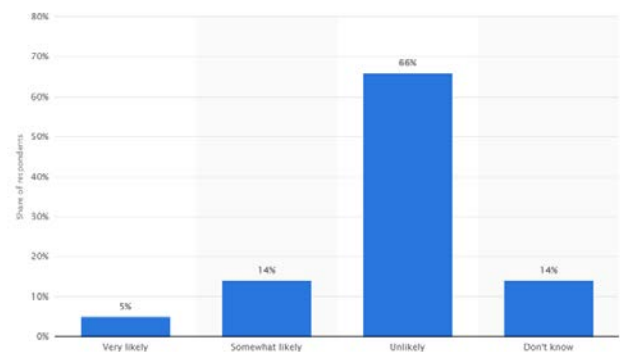


Fig 10: Shows the likelihood of buying an apple iwatch if one exists.(Source: ChangeWave, © Statista 2014)

According to this survey conducted in March 2013, only 5 percent of respondents reported that they were very likely to buy an iWatch for themselves or someone else if and when such a product might be released.

The global wearable electronics market was worth more than \$2.5 billion in revenue in 2012 and is expected to cross \$8 billion in

2018, growing at a healthy CAGR of 17.7% from 2013 to 2018. In terms of products, wrist-wear accounted for the largest market revenue in 2012, with total revenue of the most established wearable electronic products - wrist-watches and wrist-bands combined, crossing \$850 million. Among application sectors, consumer applications accounted for the largest market share, with revenue crossing \$2 billion, as of 2012. However, that of enterprise and industrial applications is expected to grow at the highest CAGR (more than 21%), during the forecast period of 2013 to 2018.

The global wearable technology ecosystem's value was estimated to more than \$4 billion as of 2012, and is expected to reach cross \$14 billion by 2018, growing at a CAGR more than 18% from 2013 to 2018. The total addressable market (TAM) for wearable technology is estimated to be more than \$14 billion, as of 2012, and the current level of penetration for wearable technology was estimated to be roughly 18%. This market penetration rate of wearable technology is expected to accelerate (increasing rate of penetration every year) over the next five years, reaching roughly 46% penetration level in the TAM, by 2018.

The global wearable electronic textiles market is expected to grow faster than that of the overall wearable electronics market, with increasing demand and growing consumer adoption for wearable electronic smart-textiles, along with expected commercialization of more advanced – wearable electronic e-textiles by 2016.

The market of electrical and electronic components for wearable electronic products is also expanding rapidly, as the market value of components amounts to roughly 66% of that of products. With dynamically changing landscape for components in

wearable electronics, the global wearable electronic components market is expected to cross \$6 billion by 2018, offering huge revenue potential for key electronic component manufacturers focusing on this field.

The research report from MarketsandMarkets (MarketsandMarkets is a global market research and consulting company based in the U.S.), based on an extensive research study on the wearable electronics market, and its entire ecosystem, describes the market trends, drivers, restraints and opportunities of the wearable electronics market and forecasts the market and all its sub-segments to 2018, in terms of both – revenue and shipments. The overall market statistics are segmented on basis of technology, components, form-factor, products application, industry verticals and geography.

This global report gives a bird's eye-view of the market across geographies - North America, Europe, Asia-Pacific, and ROW (Rest of the World). North America is the largest geography in terms of wearable electronics unit shipments and market revenue. APAC has been identified as the fastest growing region, with China leading the way. Europe and ROW are also promising markets, with Germany and the U.K. ROW is providing impetus to the growth.

This report profiles 23 promising players in the wearable technology market ecosystem and also includes market share analysis (with estimated market shares and rankings) for each of the product categories in this market. The detailed competitive landscape of the market included presents a very interesting picture, where large number of small players has become a force to reckon with. The market is witnessing a series of

new product launch an announcement and partnership across the value chain. Some big announcements by small and big players alike are expected in the coming months.

Some of the key players in the wearable electronics market include Adidas AG (Germany), Fitbit, Inc. (U.S.), Fibretronic Ltd. (U.K.), Google, Inc. (U.S.), Jawbone, Inc. (U.S.), Nike, Inc. (U.S.), Olympus Corporation (U.S.), Recon Instruments, Inc. (Canada), Vuzix Corporation (U.S.), and Weartech s.l (Spain) among others.

5. Wearable technology at CES 2014

A baby monitor that's a connected onto a onesie is drew attention at CES. The Mimo monitor connects via Wi-Fi to report the data on how a baby is sleeping. The device tracks breathing, temperature and position and lets parents analyze the data through their smart phones as shown in fig 13

Casio joins Samsung and Pebble in the smart watch market with the introduction of Sports Gear. The watch can act as a fitness tracker, control music and tell the time, including pinging your phone if you misplaced it.

Razer's Nabu is a smart band, similar to Nike's Fuelband and Jawbone's up. The health tracker reports calories burned, steps taken and hours slept, among other things. It also sends call notifications and can connect to other users, adding contacts to Twitter, Instagram or LinkedIn.

Intel unveiled a headset nicknamed "Jarvis" that is supposed to be like a personal assistant. The device works with a Smartphone app without even touching it.

From pills which can record your temperature to smart socks that monitor running techniques and a processor the size of an SD card.



Fig 11: Shows google glass in action

People are reflected in the lens of a pair of Liquid Image Apex HD camera goggles, fig which is capable of video and still photography. There is more visceral reaction to this technology than most, and part of that has to do with the fact that you are wearing it on your face, (University of Washington law professor Ryan Calo)

Google Glass performs many of the same functions as smart phones: You can read and reply to emails and text messages, take photographs and film snippets of video.

But the in-your-face nature of the technology has touched a nerve in a society growing increasingly concerned about the invasive nature of new technologies such as wearable gadgets and drones. Google has gone to great lengths to educate the public about Googleglass. It has extolled its benefits in media interviews, demonstrated the technology for lawmakers on Capitol Hill and put the technology in the hands of so-called Explorers, early testers who

essentially act as "positive ambassadors" for Glass. The Internet giant also put out basic etiquette and safety tips for Explorers, reminding them to be respectful and to ask permission before taking photos or filming, just as they would with a smartphone.

"New technology raises new concerns, which is why educating Explorers and those around them is a top priority for the Glass team," .The point of the Explorer program is to get Glass in the hands of people from all walks of life and see how they use it out in the world." (Google).



Fig 12: Blue tooth ring.

By recognizing finger gestures, the ring allows the wearer to write text messages by simply drawing in the air. The same dynamic allows the wearer to access apps by drawing designated shapes in the air. For example, drawing a music note could access your music player, while drawing an envelope shape would allow you to access your email. To activate the device, you simply press the side button on the Ring, and to receive alerts you can either receive a vibration or view the discreet little LED pinpoints near the button port. According to the device's developers, the

ring can perform up to 1,000 gestures before its battery needs to be recharged.

The only obvious shortcoming of the device at this point is that fact that it's not waterproof. That could turn into a problem for those attempting to use Ring in mobile environments during bad weather, or even inside the home, say, if you forget you have Ring on when you go to wash your hands. The Ring app can be used IOS, Android devices. The windows Phone version is still under development.



Fig 13 :A SmartOne infant sleep monitor.

The wearable device, fits into a chest pocket, and sends information and active alerts on temperature, baby orientation and breathing to a parent's mobile device.



Fig 14: A Zepp sensor

The sensors, available for golf, baseball and tennis, analyze 1,000 data points per second to create 3D representations of a player's swing in a golf game .

Reading may soon be experienced in a whole new way with a "wearable book" that creates physical sensations based on the written word.



Fig 15: A wearable vest with sensors



Fig 16: A book with LEDs positioned.

Using a combination of sensors, the book senses which page the reader is on and triggers vibration patterns through a special vest. Students have created a "wearable" book that enables you to feel the characters' feelings as you read the story. A "wearable" book allows the reader to experience the protagonist's emotions (MIT USA). Using a combination of sensors, the book senses which page the reader is on and triggers vibration patterns through a special vest. "Changes in the protagonist's emotional or physical state trigger discrete feedback in the wearable [vest], whether by changing the heartbeat rate, creating constriction through air pressure bags, or causing localized temperature fluctuations (MIT USA). The vest contains a personal heating device to change skin temperature and a compression system to convey tightness or loosening through airbags. The vest also changes vibrations to match the mood of the book. The pre-programmed responses are set to go off via sensors and actuators (Stelarc, 1997) (a type of motor) once the reader is on the right page. If a character is love the suit

might vibrate to increase the reader's heart rate and if a character is cold it might lower the reader's skin temperature. The equipment includes a body compression system, a heartbeat and shiver simulator and a localized body temperature control—all of which are responsible for the physical effects. There are 150 LEDs positioned onto the book's cover that light up based on the plot see figure 16.

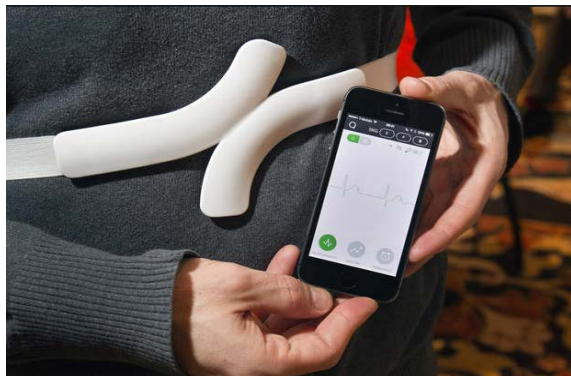


Fig 17: A Quadiocore heart monitor.

The device can send the electrocardiogram to a smartphone and the EKG can be forwarded to a physician for remote heart monitoring.



Fig 18 : A- Liquid Image wearable camera is paired with a 4G LTE. The camera and module combination make it the first wearable camera that can stream over LTE.



Fig 19: FitBark pet activity trackers

The device uses a 3D accelerometer sensor to track your pet's activity. The device retails for \$99.00 and was expected in stores in the first quarter of 2014.



Fig 20: The ZTE Blue Watch wearable computer and camera device.



Fig 21: KMS Wristband phones for young children and the elderly

The wrist phone by British-based KMS Solutions consecutively dial up to 5 phone numbers at the touch of the one button until there is an answer. The phone can also send an alert if the wearer has left a pre-described area.

6. Conclusion

Wearable technology and products intimately bind our lives to healthcare, medical, wellness, sports and fitness, and lead us to better, healthier and more convenient life. It forms an industry with a high growth potential. All in all, wearable tech's future seems solid, with functionality taking the mantle as far as the durability of the idea is concerned. The adoption of wearable technology can improve personal life tremendously. However, it still faces hurdles, with the major ones being cost, privacy concerns and a not-too-well-developed ecosystem. But with the backing of big tech firms from Intel to Google, it seems the best is yet to come. The technology is practiced in first world countries such as USA and UK. However wearable technology is yet to be felt in third world countries such as Africa.

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