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An Outline of Wearable Gadgets

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ABSTRACT

It is envisaged that technology must be made good use in order to make life convenient and comfortable in this 21 st century; more convenient when the gadgets are handy. One of the things is the wearable gadgets to take care of the emergency needs and health care. This article tried revamp the current developments.

Keywords : Wearable Gadget, Sensors

INTRODUCTION

A wearable device is a hot topic of these days, as announced by $5,000 "Make it Wearable" challenge recently issued by Intel. This is challenge which is driving both designers and manufacturers in order to conceive, redesign, construct wearable applications which will shift from personal computing into new innovative on the development of the wearables.. Wearables have been a part of our life and an important digital transformation since many years . In 1980s, when the first digital hearing aids were first released, we could not imagine that today we find many benefits from them.

More generally the wearables may be helmets, lenses , rings , belts , shoes, shirts, gloves and some electronics gadgets etc used for convenience. Wearable technologies, wearables, smart-wears, tech togs, street-wear tech, skin electronics or fashion electronics are smart electronic devices (with micro-controllers) that are worn close to and on the surface of the skin, where they detect, analyze, and transmit information concerning body signals related to vital signs, ambient data, that allow immediate biofeedback to the wearer. There are many exciting new wearable electronic devices on the market that measure blood pressure, offer sleep tracking, and let you control your phone and apps without actually using your phone. Till this day, the most useful options are watches, but rings, clothing, and especially head-mounted options make good showings. The most common current types of wearable technologies being Smart watches, Smart rings, Smart clothing, Advanced medical tech., Head-mounted displays (HMDs, Smart jewelry, Body-mounted sensors. , Fitness trackers, Smart clothing, ., Augmented reality (AR) headsets, VR headsets, AI hearing aids.

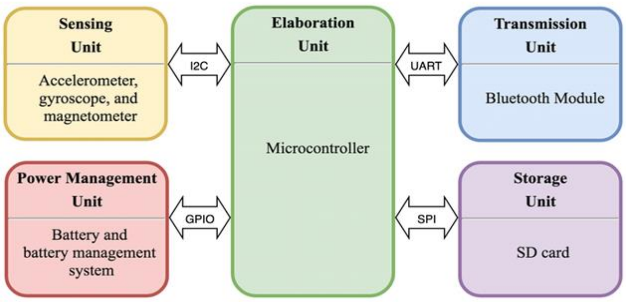
Some simple design considerations which must be kept in mind, when making a new development. In reality they are all part of the whole and must be considered in a totality. They are 1.) Understanding User Needs 2.) Choosing the Best Sensor Location, 3.) Considering the

type of Function, 4.) Displaying Data, 5.) Connectivity, 6.) Translating Data Into Action

The components components of wearables are **1.Control** - Wearable-specific microcontrollers are small, so as to be comfortable and discrete. On the other hand, the distinctive shapes and colors can function as a decorative element. Several of the boards available are hand-washable (minus the power source). Read the documentation carefully. **2. Input/Output** - In place of pins, these boards have metal eyelets which you can loop conductive thread through to sew soft circuit connections. Some boards also have snaps — or eyelets large enough to solder on snaps — for easy removal. **3. Conductive Textiles** A material containing metals, such as silver or stainless steel, through which an electrical current can flow is said to be conductive. Wearable systems can make use of these materials in a variety of ways, such as: Thread for making circuits, Fabric for capacitive touch sensors, Hook-and-loop for switches. **4. Sensors** - Sensors gather information about the environment, the user, or both. Examples of the former include light, temperature, motion (ACC), and location (GPS). Examples of the latter include heart rate (ECG), brain waves (EEG), and muscle tension (EMG). A few wearable microcontrollers have basic sensors onboard. Other manufacturers offer a range of external sensor modules that connect to the main board. **5. Power** - When scoping out a wearable design one of the first things to consider is the power requirement. Boards with an integrated holder for a lithium coin battery are nice for low-power projects that need to be self-contained. However boards with a standard JST connector (with or without a circuit to charge LiPo batteries) are more versatile. **6. Actuators** - One generic way to describe a wearable system is: In response to X, where X is the input from a sensor, Y happens. Actuators such as LEDs, buzzers or speakers, and servomotors are what make things happen. **7. Networking** - To communicate with smart devices, the internet, or other wearable systems, you need wireless connectivity. In addition to wi-fi and Bluetooth, wearable-friendly options include:

THE HISTORY OF WEARABLE TECHNOLOGY

The origins of wearable technology goes back to 13th century when eyeglasses were first invented. In the 15th century, timepieces were created -- some of which were small enough to be worn -- but it was not until the 1960s



Block diagram of a wearable device,

1) that modern wearable technology came into existence. Further in 1961, Edward Thorp and Claude Shannon created wearable technology in the form of a tiny four-button computer that could fit into a shoe or be strapped around the user's waist helped. In 1970s Wearable tech gained popularity.. The first calculator wristwatch was released in 1975 by Pulsar and quickly became a fashion statement. In 1980s Sony released the Walkman and it became the most popular wearable music device throughout the 80s. The healthcare industry was also transformed with the release of the first digital hearing aids in 1987. In 1990s Steve Mann, a Canadian researcher, invented the wearable wireless webcam in 1994. The bulkiness facilitated the use of future IoT technologies. In 2000s, this saw an explosion in wearable technology with the introduction of Bluetooth headsets, Fitbits and the Nike plus iPod Sport Kit. 2010s is a period which was the tipping point for wearable technology. Google Glass entered the scene in 2013, while the Apple Watch debuted in 2015, followed by The Oculus Rift Headset in 2016. 2020s is the gaming industry, continues to add newer AR and VR headsets, while

clothing designers are rapidly bringing smart clothing to the mainstream.

2) **THE FUTURE OF WEARABLE TECHNOLOGY:** Wearable technology is becoming increasingly popular and is all set to revolutionize the future. It may be noted that fitness trackers, smart devices, intelligent clothing and VR and AR headsets have gained widespread approval but, they are only a small part of the problem

The biggest challenge for the wearable industry is to get a sustainable customer engagement. Many wearable electronics are short lived because of its short term customer engagement. Bad quality, pain to sync with smartphones, poor battery life, uncomfortable and awful design, UX problems, are some of the functional reasons which put the user off the device. Wearable devices which are very strong functionally and physically and they failed to create any meaningful impact on the users due to their lives, habits or behaviors.

Some futuristic products and concepts are Apple **Glasses.** Initial reports from Bloomberg and The Information suggest that these AR smart glasses are designed to transfer information from a user's phone to their face. These glasses will be able to synchronize with a wearer's iPhone to display texts, emails, games and other item.. These Apple Glasses could be released by 2023.

Energy harvesting is being researched and could prolong battery life by converting body heat, movement or solar energy into power. Piezoelectricity is one example of energy harvesting, where piezoelectric ceramic is used to convert the body vibrations into energy. But one drawback of using wearable technology is that it must be taken off for regular charging.

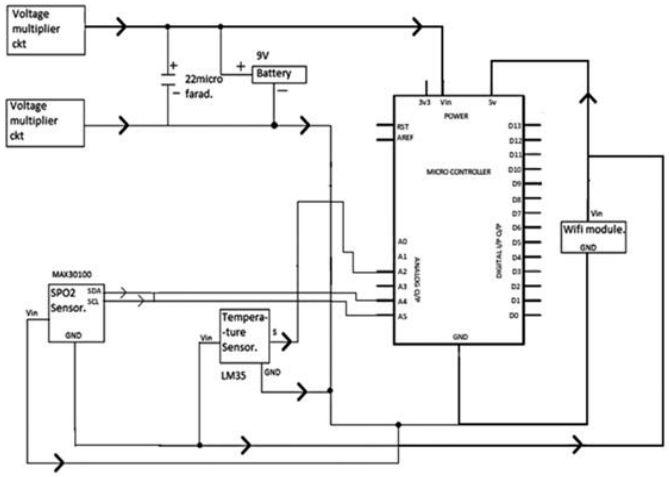
Smart contact lenses - Nothing short of a sci-fi movie, smart contact lenses that can deliver real-time information to the human eye will be available to consumers soon. Tech giants, including Google, Mojo Vision, Samsung and Sony, are working on developing these soft electronic smart contact lenses that can sync up with smartphones and other devices to provide real-time, hands-free information along with vision correction.

AI for the human brain - Facebook is developing a brain-computer interface that could enable people to type Facebook status updates by using their minds instead of typing. Elon Musk's company Neuralink is supposed to be working on an interface that could help people who suffer from traumatic brain injuries.

FACTORS THAT AFFECT THE SUCCESS OF A WEARABLE: The various factors that affect the success of a wearable related to hardware design are 1. **Low power design** - Low power consumption is critical to wearable designs and the device last longer before each charging cycle. Low power consumption is important to wearable designs and many developers are shifting to low power consumption design that is helpful to make the device long-lasting before each charging cycle. 2. **Connectivity protocols** is very important when it comes to wearable devices. One of the commonly accepted and used connectivity protocols is Bluetooth 4.2. 3. An excellent alternative when you have to transfer small quantities of data or only transfer across operational leadership particularly in 2.4GHz range. Due to low energy consumption, it allows a broader range, as it does not require more 3V battery to work. Low power consumption provides a reduction in the measurement of the battery, as well as the size and weight of the product. This in aid also decreases the cost. **Battery**. Various components in a wearable device like microcontrollers and sensors among others. This means that these components require power to perform their tasks wearable devices need to be small in size and they are also portable. Also maintaining the compressed nature of the design

factor, one of the batteries' prototypes for wearables is lithium-polymer. They are flexible and are available in several sizes and are also be customized. 4. **Human factors engineering** is one which influences hardware design of a wearable device. Human factors can include any hazard caused by faults in the device, effect of any kind of radiation emitted by the device, any harm caused to human body, and usability. Usability tests with users can be conducted in between iterations in

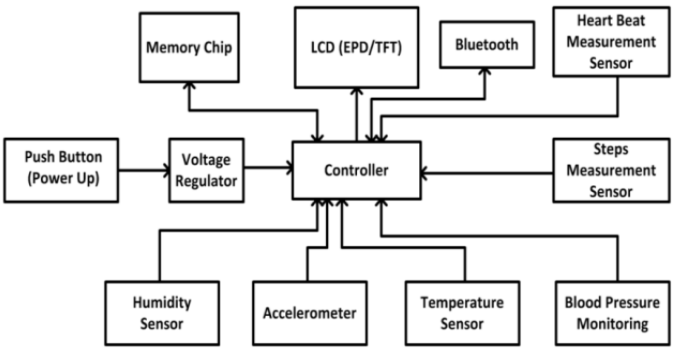
order to capture their feedback or interactions and implement changes to improve the product.



Circuit diagram and connections for the device

In fact one of the main factors that affect the achievement of a wearable product is Embedded Hardware Design. Power concerns were paramount, because without power to bring them to life, electronics are just dead metal. Wearables are electronic technology or devices incorporated into items that can be comfortably worn on a body. These wearable devices are used for tracking information on real time basis. They have **motion sensors** which take the snapshot of your day to day activity, and sync them with mobile devices or laptop computers. After the invention of smartphones, wearable electronics are the next big innovation in the world of technology.

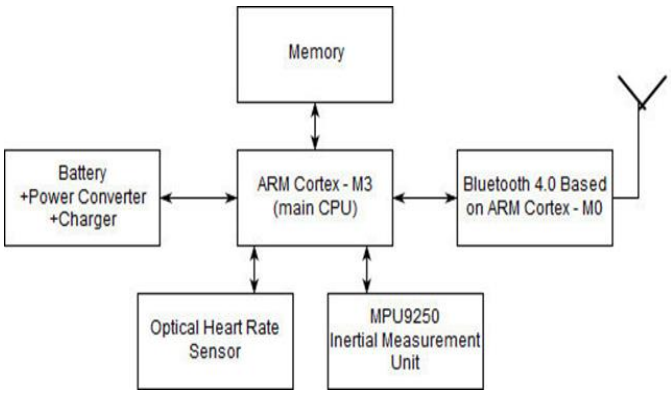
Wearable technology and wearable devices were used in the **field of military technology since a long time.** Further these devices were an integral part of the medical and healthcare sector in the military forces. 'Wearable Motherboards' or 'Smart Shirts' are also used to monitor the health of the patients.



Designing wearable that sense, think and communicate

AI IN WEARABLE DEVICES: The complex and massive data requires stronger data processing technologies . Making wearable technology intelligent, so that the value the users get at the back of every interaction should be high. This preparation has been given the name of Wearable AI. As you can infer, the sector is what has emerged out of the incorporation of Artificial Intelligence and Wearable tech in the world. Wearable devices are used for augmented, virtual, and mixed reality, artificial intelligence, and pattern recognition. These technologies commonly contain microprocessors and sensors. Additionally, these devices are usually capable of recording data and exchanging them to others over wireless connections. Various AI techniques such as supervised, unsupervised, semi-supervised and reinforcement learning (RL) have been in use to carry out various tasks. The AI based smart watches that are available in today's market have the best performance, design with several functionalities. **AI** enables these smart watches to track and keep a record of personalized preferences and activities. It helps in maintaining our health and with daily fitness goals.

IOT IN WEARABLE DEVICES: The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and have the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. A complete IoT system integrates four distinct components: sensors/devices, connectivity, data processing, and a user interface.



Wearable sensor block diagram

Firstly, sensors or devices collect data from their environment. This could be as simple as a temperature reading or as complex as a full video feed. The sensors and devices can be connected to the cloud through a variety of methods like cellular, satellite, Wi Fi, Bluetooth, low-power wide-area networks (LPWAN), or connecting directly to the internet.. Once the data gets into the cloud, software performs a kind of processing on it.

A user might have an interface that allows them to proactively check in on the system. For example, a user might want to check the video feeds in their house via a phone app or a web browser.. Depending on the IoT application, the user may also be able to perform an action and affect the system. For example, the user might remotely adjust the temperature in the cold storage via an app on their phone.

Sometimes some actions are performed automatically rather than waiting for you to adjust the temperature, the system could do it automatically via predefined rules. And rather than just call you to alert you of an intruder, the IoT system could also automatically notify relevant authorities.

HOW AN I.O.T. SYSTEM IS USED IN THE DESIGN OF WEARABLES -- An IoT system consists of sensors/ or devices which "talk" to the cloud through some connectivity. Once the data gets in to the cloud, software processes it and then decides to perform an action, like sending an alert or automatically adjusting the sensors and devices without the need for the user.

If the user wants to check in on the system, a user interface allows them to do so. Any actions that the user makes are sent in the opposite direction through the system, from the user interface, to the cloud, and back to the sensors to make the necessary changes.

User **interface, convenience, and privacy** concerns prevent people from using their wearables as part of the "internet of things" (IoT).. Wearables are the most visible consumer internet of things (IoT) technology. IoT refers to electronic devices that can be connected through internet networks. Wearables connect people to the "internet of things" through direct contact with your body – on a wrist with smart-watches or fitness trackers or on a face with smart glasses or necklaces, and virtual reality (VR) headsets. IoT-enabled medical wearable devices provide individuals the information needed to achieve better health outcomes. Health care wearables improve visibility into relevant aspects of an individual's health status. Benefits include - Real-time health monitoring. Wearable IoT devices are a key part to remote patient monitoring. Doctors can easily and reliably track health vitals, physical activity, and other vital aspects that lead to adjustments to treatment plans or interventions.

WEARABLE ASSISTIVE ROBOTICS: Wearable assistive robotics is an emerging technology with the potential to assist humans with sensorimotor impairments to perform daily activities. This assistance enables individuals to be physically and socially active and perform activities independently aiming at quality of life. These benefits to society have motivated the study of several robotic approaches. Developing systems ranging from rigid to soft robots with single and multimodal sensing, heuristics and machine learning methods with autonomous control are also some of the investigations being carried out. The current challenges and trends for the design and deployment of wearable assistive robotics include clinical and user needs, material and sensing technology, machine learning methods for god perception and control, adaptability and acceptability, datasets and standards, and translation from lab to the real world.

HARDWARE ASPECTS OF WEARABLE DEVICES: Here we are interested in as to how data is processed in wearable devices through sensors. The 6 Key Challenges of Wearable Product Development are

1) Battery Life - Battery life is one of the biggest challenges in wearable tech today. Wearable

2) Ergonomics - Ergonomics and comfort are of prime importance, when devices are to be worn for a long time

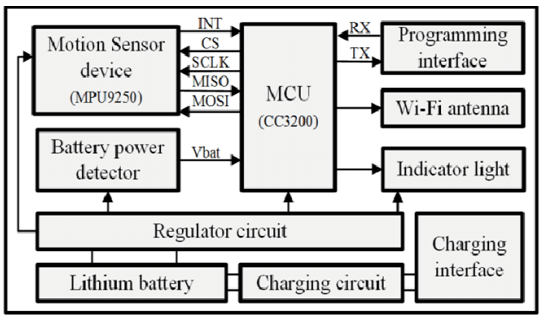
3) Differentiating and Providing Value - people buy a story to which they can relate to and express them selves about the product which appeals at an emotional level, aesthetically pleasing and marketable.

4) Sealing - Waterproofing is another challenging area for wearables.

5) Miniaturization and Integration - Effective integration of multiple antennae with reasonable signal strength at small size is difficult.

6) Safety, Security and Privacy - Lithium batteries can be dangerous if mishandled and are of substandard quality, Wearable devices containing these batteries being so close to the body all the time, there is a potential safety risk.

NEW ALGORITHEMS FOR WD s: Several years ago, wearables were still a relatively unknown device category, but today you'd be hard pressed to find a tech company that isn't involved in the wearables market.



Hardware diagram of the wearable device

Wearable players find ways to differentiate their software experience — because a wearable without good software is just jewelry weared for the sake of fashion.

Algorithms must ensure that the data should be accurate and has a wide array of movements and users. It isn't just having algorithms go beyond steps to track a more diverse range of body actions – it's also demonstrating that the way actions are measured is accurate.

As consumers become more wearable savvy, accuracy will become an even greater priority. This will be particularly true for amateur and professional athletes, where training accuracy can directly influence their ability to achieve goals. Users are hungry for data that captures all of their daily active moments accurately. More research is on the way to improve algorithms that consistently understand specific user activity across a variety of body types.

Most of the algorithms should be based on the technology and specific application areas, like medical and specific healthcare applications,. Some of them are

open source algorithms, machine learning algorithms , cryptographic applications, smart wearables, anxiety detection etc.

CONCLUSION

Five critical factors which must be taken into account for designing practical wearables for industrial applications:

1) Ergonomic product design: a. The wearables must be lightweight. b. The parts which keep contact with human skin must be made of comfortable materials. c. Occupying the user's hands or restricting the movements of wearabls due to wired connections is not an option.

2) Data interaction on device: a. The wearables should provide essential information concisely. Fully detailed information on the wearable screen may also be disturbing. b. Limiting feeding of too much typing of data on keyboard may make the process complicated, rather voice interaction is most convenient.

3) Operational stability: a. The batteries used must last more than eight hours, without charging. b. The stability of network connections such as Wifi, Bluetooth, etc. is critical and should be easily deployable and they should be easy-to-use. c. The industrial wearables must stay operational under the conditions of high temperature, humidity, and shock.

4) External software integration: a. they cannot work independently as they are required to be integrated into the enterprise systems seamlessly. b. The industrial wearables must have the ability to process data in real-time and make- decentralized decisions. c. The wearables must be designed in such a way that human experience must be involved whenever needed.

5) External hardware integration: a. The wearables must be able to collect data from machines or robots of the manufacturing site. b. The wearables must be able to control external equipment so that the user can control the equipment and intervene with the operation process if necessary. c. The wearables must support human-machine cooperation (should be able to control by a series of gestures and signs) which improves the flexibility , accuracy of the machines to improve efficiency.

Continuous improvements in design, function, and variety of available wearable devices, innovations is introduced by wearable app Development Company. Emergence of edge computing on powerful processors of the Qualcomm, Snapdragon Wear 3100 Platform with enhanced AI algorithms and advancements in wireless connectivity such as 5G, are increasing the functionality for providing a seamless user experience. Smart wearable device market will be able to sustain a double-digit growth, with 780 Million units poised to sell between 2018-2022. In future, it will be useful to also investigate the application of wearables in other domains. The role of AI methods in development of wearable devices is a very fruitful area for future research.

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