SRUSHTI

WHY A BETTER FUTURE MEANS A BETTER SENSE OF TOUCH - THE POWER AND IMPORTANCE OF

HAPTIC TECHNOLOGY

The bridge to the outside World

Introduction

Be it the Avatar, Minority Report or Iron Man, there is a common element that you can notice in most science fiction films. Very hardly can you see a futuristic narration where characters don't smoothly interact with digital content that surrounds them. With just a swipe or a gesture, you see people accessing amazing levels of information regardless of the surrounding they are in. This kind of smooth interaction with the digital world through the sense of touch is something that could soon become a norm in our day to day life. Such has been the growth of Haptic Technology. In fact, touch is one of the most underrated of all the senses. It is touch that acts as a bridge between our body and the outside world. We use touch to gain information about our surroundings and to establish trust and social bond with the fellow beings. They play a vital role in our daily experience and this is also why touch is given so much prominence when it comes to immersiveness in the digital world. For a user to feel completely immersed in the world of content, he or she must flawlessly make a connection with it through the feel of touch.

A look back at the History

The earliest usage of Haptic technology can be traced back to large aircrafts that used servomechanism systems to regulate control surfaces. In such systems, external forces deployed aerodynamically to the control surfaces were not recognized at the controls and the missing normal forces were replicated through springs and weights. In lighter aircrafts that did not use servo systems, the vibrations were felt at the pilot's controls as the aircraft approached a stall and this was a beneficial warning of an alarming flight situation. This control shake were not felt in systems that made use of servo control. To counter this, angle of attack was measured and when it reached a critical point, a stick shaker was employed to simulate the response of a simpler control system. Also there was a system that measured the servo force and signalled directly to a servo system in the control, known as force feedback.

Thomas D Shannon was granted the first US patent for tactile telephones in 1973. A. Michael Noll at Bell Telephone Laboratories, Inc created an early tactile man-machine communication system in early 1970s and it was patented to him in 1975. Interactor Vest, a wearable force-feedback was launched by Aura Systems in 1994. This device could be plugged into the audio output of a stereo, TV or VCR and the user could control the intensity of vibrations and filtering of high frequency sounds.

Geir Jensen, a Norwegian, illustrated the idea of a wrist watch haptic device with a skin tap mechanism called Tap-in in 1995. The device would connect to a mobile phone via Bluetooth and tapping frequency patterns would recognize callers to a mobile and facilitate the wearer to reply using any set of selected short messages. The project was not pursued or published until 2015 and in the same year Apple started selling a wristwatch that included skin tap sensing of applications and alerts to mobile phone of the user.

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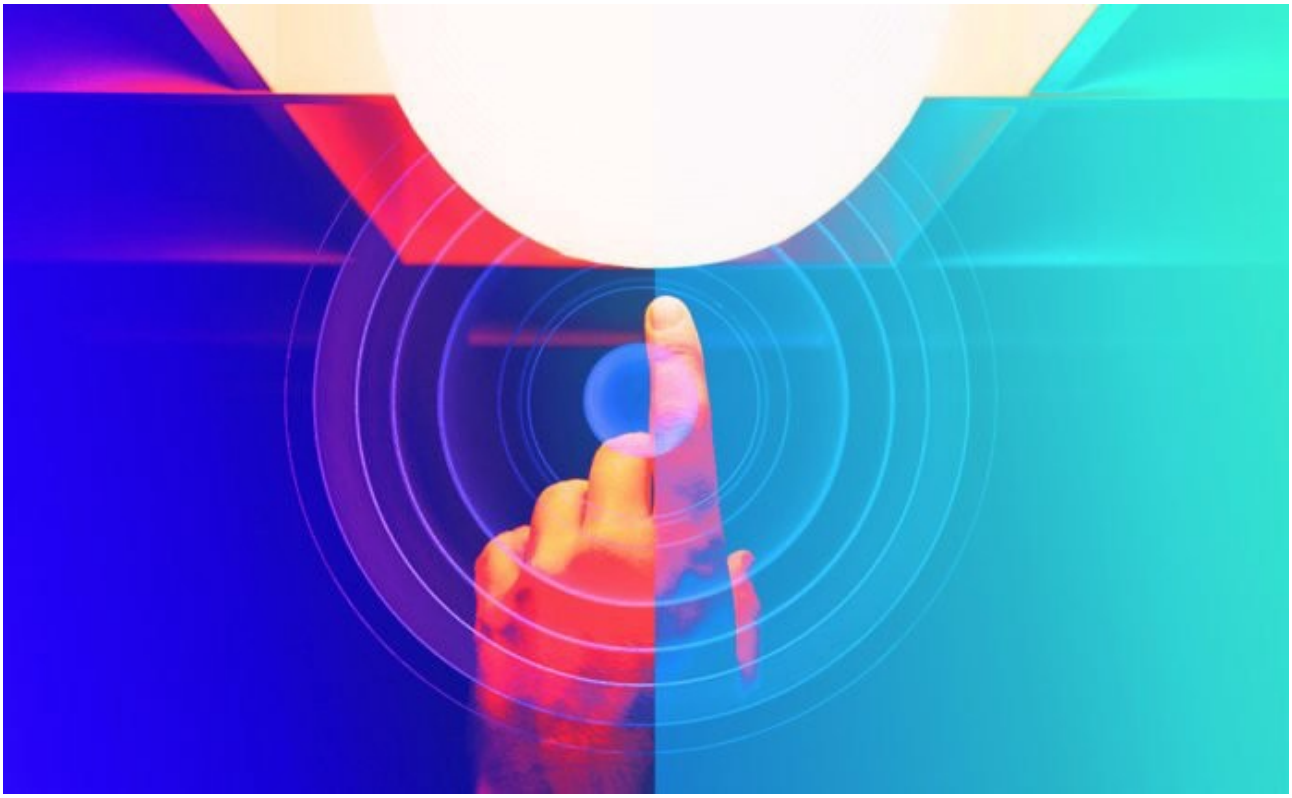


SOURCE : MEDIUM

Striking Modern Day Applications

At one stage or the other, we have all witnessed the power of immersiveness Haptic Technology can provide. A playstation or a video game set was all that we needed to forget everything happening around us. With such potential at their dispensary, it is no surprise that smart app designers, innovators and entrepreneurs came up with nourishing ideas that uplifted our standard of living. So, let us see some of the best modern day applications of Haptic Technology.

Sunu - Bracelet that helps visually impaired people navigate

The amazing advantage of technology is that the more it grows, the more it reduces the limitations for the differently abled. Sunu, Inc a Boston based startup introduced Sunu Band, that is exclusively designed for visually impaired people. Using ultrasonic technology, Sunu's proximity sensor distinguishes objects in the environment. As a person moves around the environment, Sunu emits ultrasonic waves that hit and bounce from the objects that are in the person's path and echoes them back to Sunu which results in a vibration. Sunu's indoor mode has a range of about 8 feet and they help detect entrances and exits in buildings, passages in supermarket and space between people among other objects. The outdoor mode has a broader range of thirteen feet and it helps to detect trash cans, lamp posts, hanging branches from trees etc. Sunu also has an additional attachment called 'Sunu Tag' which is a beacon like device. This can be attached to any object and the band will vibrate when the object is nearby. If the user has missed or left something behind them, Sunu can notify that too. The haptic clock can help users sense time through vibrations. Thus, Sunu can be a massive aid in the daily life of visually impaired people as they can help improve their awareness, avoid collisions and also find misplaced objects without anyone's help.

SOURCE : ASSISTIVETECHNLOGY

Paradox Robotics - For Advanced Surgeries

Minimally invasive surgeries are gaining immense popularity and it was reported that in 2015 alone almost 652,000 minimally invasive robotic surgeries were performed. But, in all those scenarios, each surgeon operated without the advantage of sense of touch. Now, imagine a surgeon experiencing haptic feedback of a person's heart as he maneuvers the robotic arm and being able to fix the problem without needing to crack open a chest cavity. This is what young Simone Braunstein aims to achieve with her startup 'Paradox Robotics'. This haptic surgical controller has three parts: the gripper that makes contact with the patient's body, operator control glove that goes to a surgeon's hand and the control board which gives power to the system. Simone's startup has an interesting tagline - "Because soft robotics doesn't have to be hard". An understanding of the operator glove is all that is needed to stamp the fact that their motto is true word by word. The operator control glover was designed using a soft robot to extend pressure on a surgeon's hand. Imagine that a surgeon is controlling a robotic gripper inside someone's body. If the gripper grasps an object, the surgeon would feel the exact shape and pressure on their hand and the device accurately replicates the feeling one would experience if he or she is actually touching the patient. This would help decrease surgical complications and improve patient safety. The project won some of the top honors in one of the most prestigious pre college science competitions - the Intel International Science and Engineering Fair. Simone Braunstein, the master brain behind the project was just 18 when she won the award! She was also named as one of 'Top 10 under 20: Young Innovators to Watch' by Consumer Electronics Week.

SOURCE : INTEL ISEF 2016 - AWARD WINNING PROJECT IN ROBOTIC SURGERY

Breathe - An Apple Application For Meditation.

Thus, it should come as no surprise that one of the technological giants Apple introduced a new platform to help people meditate. During the Worldwide Developer's Conference (WWDC) in June 2016, Apple's Director of Fitness and Health technologies introduced "Breathe", an app exclusively designed for Apple Watch. Imagine you are so loaded up with work that you feel an urgent need to relax. You just cannot allow yourself to fall into pieces now as that will ruin your entire day. You need a short break that is relaxing so that you can get back to your work with complete focus.

What do you need to do? Just get hold of your Apple Watch! Using 'Breathe', you can specify how long or how often do you need to relax. The watch will then use haptic technology to vibrate your wrist and remind you that it is time to calm down. As you slowly breathe in and out, the watch will lightly pat your wrist and move you through the target speed of your breathe. The sensation is exactly like that of someone actually tapping your arm! Once the users begin, the application reminds them to "be still and bring attention to your breath". Once the session is over, users will get a complete summary screen that indicates how many breathe sessions they completed during the day and the heart rate measured during the last session.

MEDITATION BRINGS WISDOM SAID GAUTAMA BUDDHA. REGARDLESS OF GEOGRAPHY OR CIVILIZATIONS, TODAY IT IS APPLIED ALL AROUND THE WORLD TO AID IN OUR BUSY AND HECTIC LIFE STYLE.

Ultrahaptics - Feel Without Touch

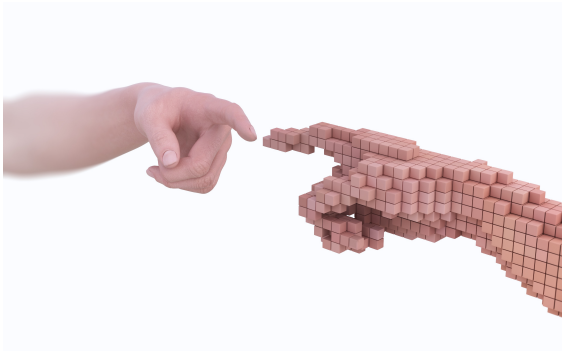
How do you feel the sensation of wind? You cannot see it, you cannot grab it using your hands but yet you can feel it. This is exactly what 'Ultrahaptics', an England based startup is trying to bring into the haptics arena. By using sounds known as ultrasounds that are too high for humans to hear, Ultrahaptics aims to create the sensation of touch without any physical contact. The technology of ultrasounds have been in use in pregnancy for quite some time now, but its application in haptics technology opens up a whole new realm of possibilities. To make a user feel something through sound, Ultrahaptics makes use of multiple tiny speakers that generate sounds of very high frequency. When soundwaves focus at the same point same time, the strong force behind the sound gives a user a feel as if he or she has touched something. Through Ultrahaptics, the goal of Virtual Reality can come to a complete circle. Through visuals and sounds, VR does give a feel of wandering around a 3D space but the feel of immersion disappears when you try to touch an object within the 3D space. With Ultrahaptics you will be able to feel things in Virtual Reality using mid air touch. The company claims that they can create any kind of vibration on the hand. From smooth sensations to a Star Wars kind of Force lightning, rain drops, foams and everything!

SOURCE :ULTRAHAPTICS IN ACTION

Digits - 3D Hand Tracker

At the annual conference of User Interface Software and Technology (UIST) 2012, Microsoft introduced a new technology known as 'Digits', that could track hand movements using a device worn on the user's wrist. They can detect hand position in 3D and then convert them into software commands. This means that a user could swipe their hand to turn the pages in a file or nip their fingers to zoom into a document. 'Digits' can also show a human hand on screen when necessary. The prototype launched in UIST consisted of an infrared camera, laser line generator, diffuse illuminator and an inertial-measurement unit. Microsoft aims to cater this device as an input method for tablets, cell phones and Kinect. When the finite details of

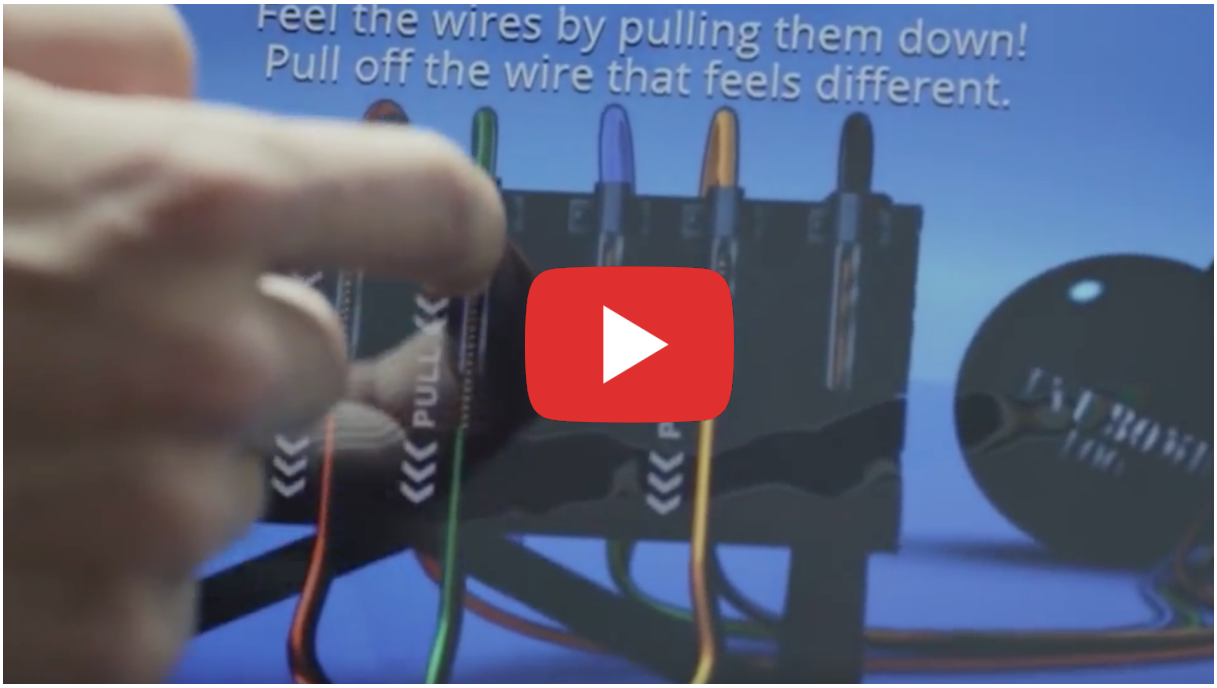
Digit combine with the full body tracking of Kinect, it could make the whole gaming experience more realistic. Since the device is not depended upon any external infrastructure, a user is free to move around while interacting with their electronics. As human computer interface dives into deep horizons every year, technologies such as 'Digits' will have a huge role to play in how we connect with computers.



SOURCE : DIGITS HAND TRACKER: FREEHAND 3D COMPUTER INTERACTION WITHOUT GLOVES

Senseg Haptic Tech - Feel Tactile Objects On Screen

Suppose you are playing a game like Need for Speed and you wonder how that astonishing car would feel like in real. Or when you shop online, you feel like testing the quality of the shirt or the dining table you are about to buy. Senseg Haptic Tech might just have the answer you are looking for. The technology is deviced for tablets and other devices with touchscreen support that provides users a feel of tactile sensation through the screen. The tactile panel of Senseg makes use of electrostatic fields to replicate different levels of resistance and it allows them to create a sensation of texture on a complete flat screen. Compared to other haptic technologies, there is no dependence on moving parts or physical change to the screen and thereby Senseg can be adapted to the same devices that we use today. They use electric tixels instead of pixels that help pull the finger skin towards a computer screen surface and the textures are created using an ultra-thin, ultra-durable coating. So, the next time you play an instrument in a music application or hold a gun in a game, you might be able to get a real feel of them!

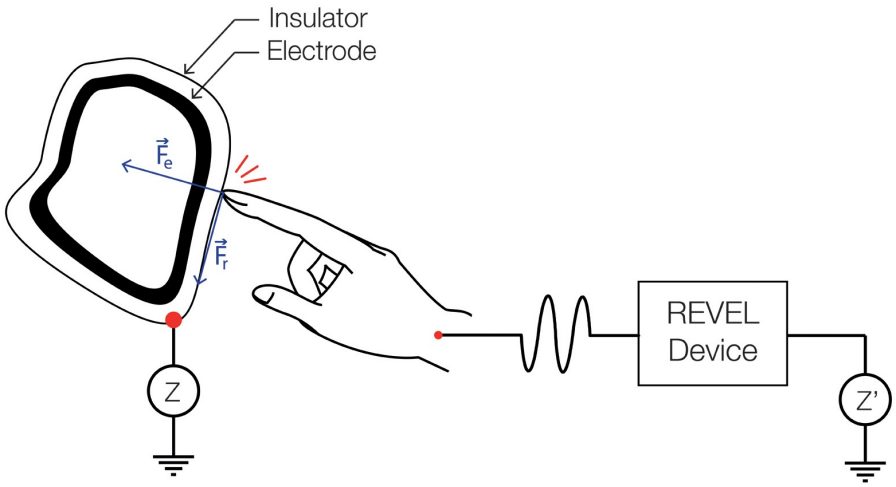


SOURCE : NEXT GEN TOUCH SCREENS, FEEL THE THOUCH - SENSEG DEMO

REVEL - Augment The Sense of Touch

REVEL - a new wearable tactile technology introduced by Disney Research aims to improve a user's tactile apprehension of the physical world. They can provide artificial tactile sensations on touch screens as well as everyday objects and surfaces such as furniture, walls and even human skin. Based on Reverse Electrovibration, it generates a varying electrical field around a user's skin by infusing a weak electrical signal into anywhere in the body. As a user slides his or her fingers around the surface of the object, he or she experiences a very unique tactile texture that elevates the physical object. Based on the shape, size, amplitude and frequency, the resulting tactile sensations will also be different. The technology can massively empower the next generation of touchscreens, augmented reality and even help blind people find their way around.

SOURCE : REVEL: PROGRAMMING THE SENSE OF TOUCH



Source : olivierbau

The Future

As we have seen before, touch is one sense that connects us to existence. Most significantly, it is touch that defines how we feel. The better the sensation, the better we feel. Now imagine how life would be when that sense is elevated to the highest possible degree. When every possible surface or object is fine tuned to provide us with the best possible sensation, life will never be the same. Let us take a look at some of the glorious opportunities that the growth in haptic technology could end up providing.

Turn Everyday Objects Into Touch-Sensitive Devices

Disney never ceases to amaze the world. Be it entertainment or technological progress, they always strive to be the frontrunners. And in 2012, the Disney Research team introduced a new touch-sensitive technology called 'Touche', with the idea of allowing everyday objects to sense human touch. They built a smart doorknob, a doorknob that could recognize the way you are touching it. Using capacitive sensing, a kind of touchscreen technology, it senses small amounts of electric charge moving from touchscreen to a finger or hand and thereby the doorknob could tell if it's a light or strong touch or a grasp. This means that it can recognize whether you are just moving out of your cabin to take a coffee break or you are done for the day! Normal touchscreens recognize movement by a built-in electrical circuit that operates at a single frequency. Touche makes use of multiple frequencies to differentiate between single finger, several fingers, a full hand grasp and other gestures. A single electrical wire attached could analyze the different electrical signals between the doorknob and the hand to identify a gesture. There are many ways in which you could make use of this technology. For example, this can be used as a credential for access in your workplace. The way you touch the doorknob could lock and unlock it. So, instead of investing in costly security access control systems, a firm could simply secure their establishment with smart doorknobs! In individual apartments, you could say goodbye to traditional locks and keys as the manner in which you close the door would automatically lock it.

Imagine the kind of possibilities when this becomes applicable to almost all your daily objects. Suppose you are taking someone to a hospital in your car. What if the steering and entire vehicle can sense your urgency and respond accordingly. What if it can send corresponding signals to the other vehicles and passengers on the road so that they can make way for you. At some stage in life, most of us would have gone through this difficulty in transportation during an emergency. The growth in haptic technology can be a big game changer in this regard.

You are late for office or to your friend's birthday party and you scamper to reach as soon as you can. What if your shoe could sense your urgency and help you move fast! Such smart wearables will easily be able to differentiate between a jog workout and your hastiness. Similarly, the way you move your hands around a keypad could tell the keyboard the urgency of the work you are in and help you complete it in time. By reading your finger movements, they will be able to type out the letters even before you reach for it in the keyboard! Smart sensors attached to your wrist can tell a fridge what do you prefer to have in a certain condition and pop them up as soon as you open the fridge. Imagine you are back after a hectic workout and you are sweating and panting like anything. Your fridge will be able to sense your feel and just as soon as you open the door, your favorite drink will appear out of the storage bin! Similarly, when you switch on your air conditioner, sensors will be able to read your body temperature and automatically adjust to the required temperature. The possibilities are simply enormous.

Education

SOURCE : TEARS OF JOY - MY DAD W/OCULUS RIFT DK2 AND APOLLO 11 VR

Virtual Reality is expected to transform future education and without proper haptic technology, VR cannot be explored to its maximum. In fact technologies such as Virtual Reality, Augmented Reality, Mixed Reality, Artificial Intelligence and Haptic Feedback are already showing signs of going in hand to hand to shape up our tomorrow. From single celled organisms to the modern day homo sapiens, what if you could explore in depth the sub atomic and molecular particles of all the species in evolution since the last 3.8 billion years!

You might have read about the coin system or clothing style of ancient civilizations. Now, what if you can experience them right in front of your eyes. You can take a look at William Wallace's Sword or the mastery behind the empire of Akbar. The rise and fall of civilizations, dynasties, monuments, the birth of language, monetary systems, transportation, communication systems.. all of them will be awaiting your interaction. In other words, in the future, the past will be interactive!

Immersive education, an educational software company based in Oxfordshire, England created 'Apollo 11 VR' that retells the story of man's first landing on Moon. Students could experience the historical event through the eyes of those who lived it. The team made use of original archive audio and film to successfully depict the spacecraft and locations. Students can not only relive the events of 1969 but can also take control of the command module, land the lunar lander, explore Moon's surface and also station lunar experiments before returning to Earth. The same team also created 'Titanic VR', that allowed users to explore the shipwreck of RMS Titanic and witness the tragedy from the point of view of a survivor. This immersive experience is categorised into two parts; an underwater exploration game and a historical cinema experience. In the first section, a user can take control of the ship to explore the ruins and complete different missions and recovery tasks. The project presents a different method to learn history by solving the mystery. The second section consists of the immersive experience where a user can witness the key events as a survivor.

As one can easily guess, history is not the only subject that gets easier to learn. Imagine you are learning geography. What if you could really experience the various

SOURCE : A BREATHTAKING JOURNEY TO THE MOON! | APOLLO 11 VR HTC VIVE VIRTUAL REALITY GAMEPLAY

physical features of Earth and its atmosphere. When you are learning about different kinds of rain, cyclone or types of soil, you can easily get yourself immersed to understand how they shape up. When you are learning astronomy, you could actually explore the star or planet you are learning about. We know what it took for 'Cooper' to go on that 'Interstellar' journey. In the future, probably one can remain in his or her classroom and explore a planet or a star anywhere in the universe! You know the theory of gravity or relativity from books. Very soon, one can actually live through them and actually check out what happens if gravity stops or light travels slower. We know two atoms of hydrogen and one atom of oxygen makes water. You could witness how chemical formula helps bring any matter alive and even change its composition to see what after effect will it result upon. As Haptic Technology grows in power, education will be an interactive and playful experience.

SOURCE : ASTRONAUT CHARLIE DUKE PLAYS APOLLO 11 VR ON OCULUS RIFT

Communication

Data and information should move from one place to the other. Starting from letters, telephone and modern day wireless methods, mankind has always ventured out to send and receive messages around the world. With every passing year, the barriers in communication gets narrower too. Today, no matter how far you may be geographically, you can still communicate with your loved ones by viewing them in real time. But still, there is something that makes the modern day communication incomplete. Though you can see the person at the other end in real time, you don't really feel like you are with them. You can be working in the United States and yet feel the caress of your beloved Mother in India. You can be on an official duty in Paris and yet feel the hug of your spouse who is in Japan.. So..

This is what Haptic Technology could provide you in the future. With Virtual Reality about to take over the Internet, you can communicate with any person anywhere in the world as if they are right in front of you. And when Virtual Reality improves their interactiveness through Haptic, communication will be a broader game than just speaking and listening. when two people communicate, they are totally and completely together. Haptic Technology could entirely vanish any obstacle of geography so that the people you love are always with you whenever you need them.

Take the case of an enterprise or a corporate. Normally, they are spread around the globe and communication across various divisions do not happen smoothly and instantaneously. But, in the future, a person of authority could interact with any division and address their point of concern without any trouble at all. This can save massive amount of time and manpower as an establishment will not have to assign an individual to physically migrate to the point of concern. Similarly, executives can easily oversee the works happening in different geographies and interfere immediately if there is any matter of concern. Coordinating the thousands of employees within a firm will also become smoother and efficient as there will be more direct and regular communication from the concerned executives. Employees and Management from various divisions can also meet up regularly to discuss various factors connected to running the business.

Medicine and Healthcare

'Paradox Robotics' gave us an idea of about how Haptic technology can revolutionize the field of medicine and healthcare. One may not be wrong to say that it is advancements in the healthcare industry that has helped mankind thrive and survive this far. Diseases that were seemingly impossible to cure have now become easy to solve cases for healthcare specialists. With Virtual Reality, Artificial Intelligence, 3D Virtual Worlds and Haptic Technology on the rise, healthcare is set to conquer every possible territory there is.

On a typical scenario, it is you who goes and sees a doctor. But what if you can bring the doctor to your room. And not just the best doctor in your locality. The best doctor in the world! When VR becomes a common entity in the web, you can just take a visit to a virtual clinic set up anywhere in a Metaverse and get yourself attended by the best possible doctor. There will be virtual digital assistants in the form of automated robots in every virtual clinic that can direct you to the best doctor you will need. With Haptic Technology, the sense of touch will be uncompromised and you can feel your doctor's fingers on you remaining thousands of miles away. Doctors will not even have to open you up in case of a surgery. Smart Dust, a system of numerous tiny microelectromechanical systems such as sensors, robots and other devices that can detect light, temperature, vibration, magnetism, chemicals etc are soon expected to have a widespread presence.

So, you can visit any doctor of your choice using VR and if needed doctors can easily implant a smart dust, diagnose your problem through a computer screen and treat it with simple computer programs instead of all the complex surgery! Sensors attached to your body can give instant feedbacks about your health to your specialist and either he himself or a virtual assistant can appear before you and remind you to have your medicines or increase your daily workout. Any potential threat in your health can be detected at its earliest stage of interference.

Medical students can gain experience from surgeons anywhere in the world as they can easily participate in a live surgery. Additionally they can also conduct their studies and experiments in real lifelike 3D replicas that will give the exact same feeling of touch as a human being. This will significantly bring down the cost incurred in teaching and also the risk associated to a patient. Students can easily be taught on how to deal with an emergency situation and keep them prepared to face that in real life. For example, they can be provided with a three dimensional demo situation where they have to save a patient in the next five minutes. The training can be repeated any number of times so that there is no panic or unrest when such a situation happens in real.

Engineering and Architecture

Look around you. There is a masterful design in almost everything that we see around us. We may not really give due credit every time but every little thing that we see around is the end result of a creative design. From the pen in your hand, to the water bottle, note pad, computer table and even the building you work in! Engineering, design and architecture have played a great role in making the world as beautiful as today. It is going to look even better with efficient utilization of Haptic Technology.

In a traditional method, a designer gets to see his product only after it has completed production. So, even if the design was made through careful consideration, there are still possibilities for minor flaws. Imagine the kind of time, money and energy that is wasted here. But what if instead of waiting for a prototype, you could see your end product the moment you design it. This is where modern day 3D visualization and VR techniques are taking us to. Without proper Haptic Technology, these methods serve absolutely no use. As you design, you could see how each part would appear in the end product and you could go on to make modifications. For example, with gestures you will be able to design a car bonnet and instantly see how the bonnet would appear in the final car. You can easily try any number of designs as you wish until you find the best one. So, while designing any product, future Haptic Technology will provide the designers greater flexibility and they will instantly be able to come up with quality solutions. Designers from anywhere in the world can remain in their own living rooms and work on a product. Through efficient visualization and haptics, they can smoothly collaborate with each other. Everyone will clearly know what the other is working on and how their work will reflect in the final product. They can also get any of their queries instantly addressed. The same benefits can be reaped by the industry of construction too.

BUSINESS

The purpose of a business is to create a customer who creates customers said Shiv Singh, the Senior Vice President of Global Brand and Marketing Transformation at Visa. The customer always want more and they need them in an easy way. This is why the world of business is curiously waiting to cash in on the opportunities that Haptic Technology aims to provide. Very soon, with Virtual Reality on Web, you could see yourself inside a virtual store or a supermarket. But what is the use of such stores if you don't get a feel of touch. When you are buying a shirt of your choice or trying to get a dining table to your home, you need to check out how they feel physically as in real world to be convinced to make a purchase. Otherwise it is just a fancy technology that will stand apart from the real world. Just as in the real physical world, you need to properly perceive the finesse of the cloth or the quality of the table for virtual stores to be effective. And thankfully, that is indeed possible. Additionally, you will even be able to expose them to possible situations where you might be using these products. For example, if it is a dining table, you will be able to keep the table on a replica of your dining room and see how well does it look! You can also add various things on top of the table and check out how spacious or comfortable it is. Similarly, if you are buying a car, you can take it out for a virtual ride over your city to see how the car would fare in your town of residence. You will even be able to access virtual product manuals that will give you details regarding the kind of labour that went into production, the possible threats for the longevity of the product, common malfunctions and how you can fix them.

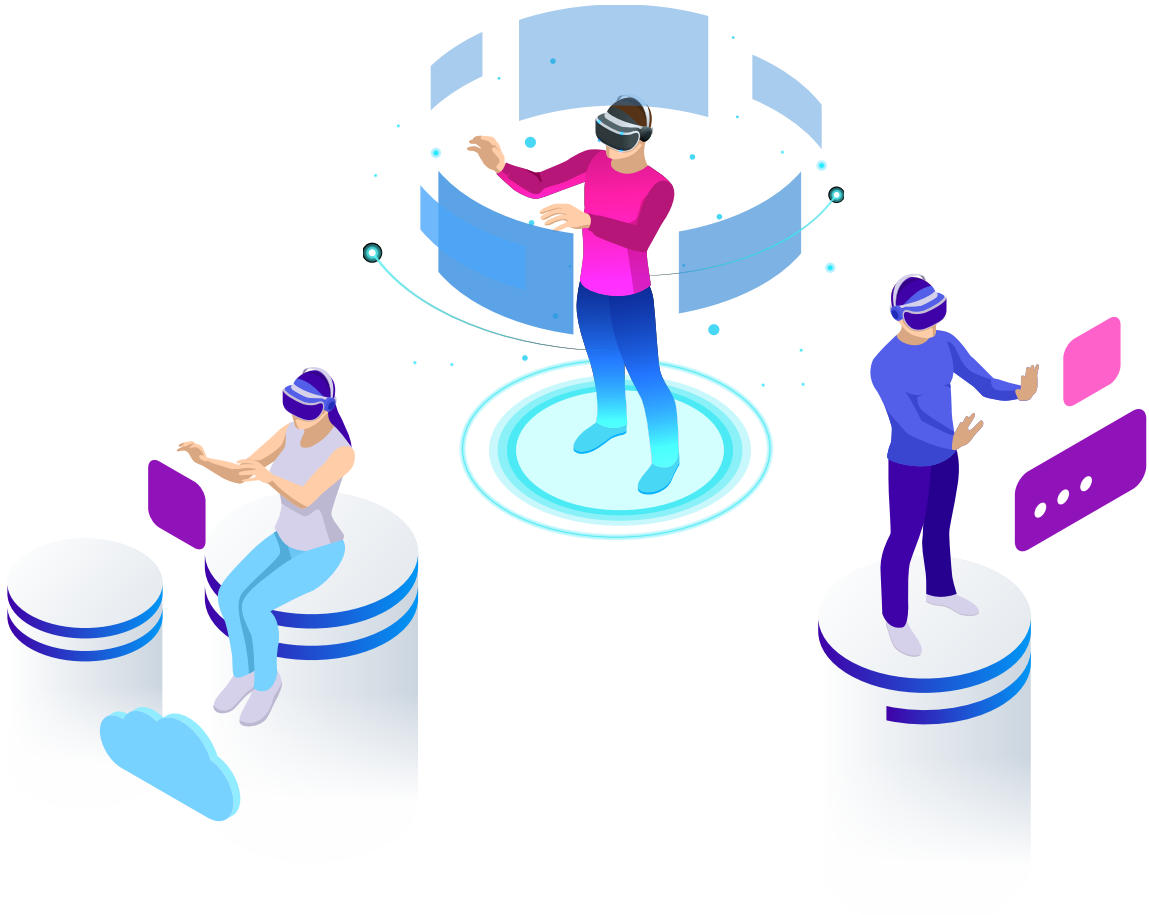
ENTERTAINMENT

Video games have always focused on a user's sense of touch. The journey from primitive joysticks to modern day gesture controllers were driven by one aim. To immerse a user in the world of the gaming environment. But even today, there is one barrier that stands between a user and complete immersiveness. A gamer is still outside the gaming world. He controls the game and characters remaining outside the world of the games. But what if you could actually be inside a game and experience everything that a character experiences! In other words, you will not have to control any other character. You yourself will be the main character of the game and you can move around the unique world in the gaming environment. So, you will be the Super Mario that is on the quest to save the princess or the firing commando in Contra. You can get a real feel of escaping those dangerous animals or kicking the baddies down. Maybe in the future, when doctors ask you to work out more, you could go on a mission in a super mario like game or race in a game like Need For Speed! Modern day 3D movies do provide a sense of immersion but it is not 360 degree immersiveness. You cannot turn around anywhere and still be within the movie world. Just like in gaming, in the VR driven future world, you could find yourself inside the story world of the movies. With Haptic Technology, you will be able to interact with the characters and the story will move forward depending upon how you move the characters around!

So, you will be able to join Tom Cruise to solve the mystery of Egyptian Mummies or join Cooper in the Interstellar journey! You will be the narrator and no two people will ever watch the same movie. So, when you hang out with friends and discuss about the latest movie, you could actually talk about the different missions you endured upon with the hero!

Conclusion

Love, compassion, joy, affection, warmth… All our emotions come alive through the sense of touch. Be it the physical world or artificial, the sense of 'reality' is massively governed through touch. So, it is obvious that a better future will need heightened response to touch stimuli. When Haptic Technology together with other promising innovations such as Virtual Reality, Augmented Reality, 3D Virtual Worlds and 3D Visualization rise to prominence, our entire perception of the world will be elevated to a whole new level of grandeur.



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