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Artificial Intelligent Bionics; Disability to Exceptional Ability

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----------*ABSTRACT*----------
Humans need motivation, momentum, and a reason to get up in the morning and to live for, a goal to work for, a dream to make it reality. Unfortunately, in case of accidents, amputation, and paralysis, all the reasons, goals, and dreams are demolished because the disability. Disability at the beginning is very hard for any human to take and to adapt to. A decade ago, prosthetics were the only solution but also help a small percentage but things have changed, technology has evolved. The rise of "Bionics" in the recent years has prompted some interesting thoughts of the human future, the birth of "Artificial Intelligence" (AI) has facilitated the complex computations for reality simulation, the revolution improvement in surgeries, the unlimited computational resources of the public cloud, and the new communication era of wireless 5G, all combined have given the hope for a new and better future not only to reverse disability but to empower the humans with more capabilities, to be faster than they can ever be, stronger than they can ever dream of and more. Today we humans are able to trade away our biological body organ for a repairable one that will not age. The ambition is not stopping there, from being a "Cyborg" capable of doing more than the biological human can do, to the next evolution which is for humans to control avatar robots on Earth planet or on the moon or even eventually Mars planet through direct brain communication between the man and the machine with no needs to an intermediate system. All these technologies seem to be impressive but in fact the astonishing part of all that is the humans themselves are the reason to make all that happen. "life can't just be about solving problems otherwise what's the point, there's got to be things that people find inspiring and make life worth living" Elon Musk.
KEYWORDS;-*Bionics, Cyborg, Biofabrication, Neuralink, Intelligent Amputation Surgery, Spinal Stimulation.*

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I. INTRODUCTION

To reverse disability, we need to understand how the human biological body works, the brain, the senses and the organs' motion techniques. There, we put the state-of-the-art technologies to work, to simulate motions, to invent new methods on performing amputation surgeries to preserve nerves, to help us to build new biological sensors able to transfer messages to the brain, and to manufacture new bio-materials to interface between the intelligent advanced prosthetic and the human body. Traditionally we think of humans as having only five senses; smell, taste, touch, sight, and sound, however with the bionic epidermis, we might be able to live in a world beyond the concept of "as is". Essentially, there is no limit to the amount of new senses that transhumanists could invent because "Sense" is really just any input into the brain that is capable of being processed independently, we could potentially add any number of new senses. All Humans' senses are at the end electrical impulses which are the universal language of the human brain [1].

Today, we are not bound by convention sensory way, we are in a new era, the era of sensory substitution which means feeding information into the brain via unusual sensory channels, deaf individuals, blind individuals, individuals who are not able to speak, or walk or function normally because of their conventional sensors are damaged or naturally were not available or functioning, their brain have not been fully utilized yet as for the normal humans, their concisions have not been contaminated yet with the life around us [2]. Imagine for a moment, we bypassed those non-functional sensors and communicate directly to the brain and start utilizing it using new technologies, those individuals will be happy, productive, and we believe they are the next super human generations, but the question is how. That exactly what we are going to cover during this research paper [3]. We will start with how the biological human brain works compared to the Artificial Intelligence (AI), the research paper will also cover the revolution of the advanced amputation surgeries, biofabrication, spinal stimulation as the foundation of bionics technology, and we will end the research paper with the recent technological evolution "Neuralink" which could possibly cure diseases for centuries they were considered the end of a human life with no cure ever known to man.

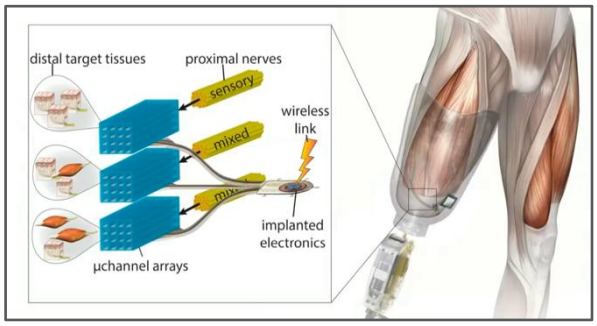

Figure 1. Bionics Sensory Channels

II. CYBORG

Humans and machines, biology and technology, are becoming one; "Cyborg". Cyborg is a living human being with computerized or mechanical implants designed to replace or enhance aspects of their existing bodies. It is not any longer to be found in movies and comic books, it is real.

What have led to that is the outstanding advancement in Artificial Intelligence (AI) and the unlimited resources of the public cloud environment, it is an impressive titanic shift and it happened in just two decades, from exoskeleton - a frame that goes over a man's body and moves the limbs allowing paraplegic to walk, to motorized arm that one is able to use for a range of tasks just by thinking about it.

If we connect a cyborg to the cloud which in reality means connecting humans directly and wirelessly to the cloud, we can control muscles movement which means reduce crimes, no need for guns at all. Since IoT (Internet of Things) is about connecting things aka devices to the internet, we believe by connecting the humans to the cloud, it is expected in the future to have IoH (Internet of Humans) as well [4].

Figure 2. Human Cyborg

III. HUMAN INTELLIGENCE VERSUS ARTIFICIAL INTELLIGENCE

The human brain is the most powerful supercomputer in the world. It helps us navigate our environment by carrying out about one thousand trillion logical operations per second. For centuries we have been trying to map and understand it, and most recently to replicate it. The brain is certainly a computer that has been evolving for nearly four billion years, and the more we learn about the brain, the more we are able to benefit from it and incorporate what we learn of the smart ways that it does computation into our artificial devices.

The brain is packed with neuron cells that constantly communicate with each other through electrical pulses, known as spikes. Each neuron releases molecules that act as messengers and control if the electrical pulse is passed along the chain. This relay race is happening simultaneously throughout billions of neurons, much like the zeros and ones of the computer world, this is the basic language of the brain [5].

There are certainly things that computers do much better than the human brain such as adding or multiplying big numbers because this is what they were designed for. The brain works in a different way, the brain is a machine learning organ to be able to build an internal model of the surroundings when we hear a noise in the bushes, it could be the wind or a predator. The brain also needs to be able to recognize faces in order to live in a society where people can actually communicate and cooperate, and this is what evolution has made our brains excel at.

This ability to build an internal model of the world, to have the world inside our head, to imagine what is happening around us even if we do not see it, which is critically important for a true artificial intelligence. One thing that today's artificial intelligence needs in order to be able to perform whatever task it was designed for is a lot of examples to recognize the object whenever it sees another object of the species. AI like Google image recognition, Alexa or the auto pilot in a self-driving car, all work properly, thanks to neural networks, the software which already tries to imitate the way our brain recognizes patterns.

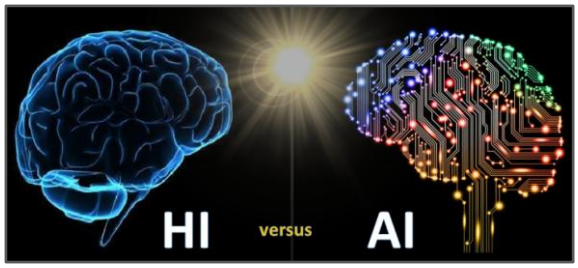

Figure 3. Human vs Artificial Intelligence

IV. INTELLIGENT AMPUTATION SURGERIES

The human brain is the most powerful supercomputer in the world. It helps us navigate our environment by carrying out about one thousand trillion logical operations per second. For centuries we have been trying to map and understand it, and most recently to replicate it. The brain is certainly a computer that has been evolving for nearly four billion years, and the more we learn about the brain, the more we are able to benefit from it and incorporate what we learn of the smart ways that it does computation into our artificial devices.

We are taking aggressive steps towards building cybernetic systems or we call it "Cyborgs" not science fiction anymore, it is science fact, humanity has the opportunity to end disability. Bionics will make disabled humans to see, to feel, and to experience things that he would have not otherwise been able to if surrender to the disability state. For that to happen it needs to start with intelligent amputation surgery [6].

In a traditional amputation, not only they are cutting through the bone but they are also cutting through all the muscles and tendons as well. Ewing procedure is an intelligent amputation surgery, it is a revolutionary technological surgery, they preserve as much of that musculature as they can and the relationship of those muscles via their tendons which means still have the musculature embedded into the limb, what it means is that the person can have a direct neuromuscular interface with bionic limbs. The goal is that sensors that read the signals coming out of the muscles in the leg and it translates them into mechanical motion within the bionic limb, so when the disable person fires a muscle, that would point the foot down for example and it directly translates it to a motion [7].

To close the loop between the human and the bionic external limb, with the intelligent amputation surgeries, growing nerves through micro-channel arrays to sense how the person wishes to move that can be sent out wirelessly to the bionic limb, so the person with synthetic limbs that move like flesh and bone but actually feel like flesh and bone.

Figure 4. Intelligence Ewing Amputation Procedure

V. BIOFABRICATION

Just few years ago, biotech companies for BioBots invented a new technology "Biofabrication". They launched a desktop 3D printer, simply instead of plastic, a special ink is used combined with biomaterials like collagen and cultured cells to build a living tissue and human organs, they demonstrated the printing of a replica of Van Gogh's ear. Eventually we will have printable noses, lungs, kidneys, and it will be affordable financially and on-demand. A new era has begun, the era of "Transhumans" which means embedding machines directly into the human body [8].

Scientists at Seoul National University, South Korea unveiled research on synthetic smart skin, life-like ultra-thin crystalline silicon, designed to cover prosthetic limbs, giving the user all the sensations of a natural limb providing feelings whether it is hot or cold or applying pressure. These future artificial limbs and smart prosthetics will be controlled directly through the brain.

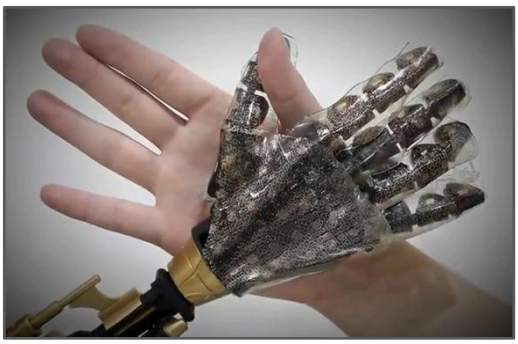

Figure 5. Transhumans

Kevin Warwick, British engineer and Deputy Vice-Chancellor at Coventry University, United Kingdom had a surgery for implants 100 small electrodes fired into his nervous system to link his nervous system with a computer, like plugging a plug into an electric socket, but the socket here was his own human nervous system. He was able to extend his nervous system to control a robot hand from his brain signals.

VI. SPINAL STIMULATION

When a human has a spinal cord injury, he is likely to lose the communication between the brain and the spinal cord, which is a devastating injury because the traditional way of thinking about a spinal cord injury is that the brain is the primary controller of movement and function. It turns out, the spinal cord has much more of a sophisticated role than we thought before, the spinal circuitry is as smart as the brain, it can learn, it can remember, it can forget, and it can make decisions, that circuitry still has the ability to do that, but it loses what we would call state of excitability. But what if we can regenerate that connection, a successful experiment was conducted, scientists implanted an individual with the epidural stimulator which is an off-the-shelf pain stimulator that is used in people for pain. It has a lead that is placed in the lower spinal cord, and it generates an electric field. So, the stimulator actually helps those neurons that are still viable and still alive to be able to function like they did before, the results were surprising, the patient was able to move his toe. Then they took it to the next challenge which is to stimulate the neural networks in the spinal cord with the goal of helping the spinal cord to relearn how to do things it was able to do before the injury and it was also successful.

Figure 6. Spinal Stimulation

Today's technology cannot completely regenerate a stimulation of the spinal cord after an injury, but it makes an incremental change in function, it improves their participation in life. Tomorrow we might get to complete what we have started and reach the goal of complete stimulation of the spinal cord [9].

VII. BIONICS

We are beginning the age in which machines attached to our bodies will make us stronger, faster, and more efficient. Bionics explore the interplay between biology and design. Bionic integration is about how electro-mechanics attached to the body and implanted inside the body are beginning to bridge the gap between disability and ability.

Bionic implants have started turning science fiction into reality and our daily lives are becoming increasingly less distinguishable from a cyberpunk fever dream. Bionics is defined as the science of connecting biological systems to artificial systems to develop machines that can imitate our biology. One of the most important aspects for the merger of a human and a machine is the transition of our sensory perception, this can be in the form of an implant that mimics a sensory organ or an exoskeleton that imitates human movement, it can be an artifact that mimics human organs or nano factories that give you on-demand smell vision. As these bionic systems and transhumanist augmentations exceed our physical capabilities, humanity might soon face an interesting dichotomy; either remain physically inferior but embody the cherished values of humanism as we know them, or become a superior transhuman with a repairable body that can transcend the decay of aging. If you choose the latter it will involve switching out literally every part of your body with prosthetics that can do the job equally if not better. This decision might be sooner than we think as many of our natural apparatuses are finally becoming replaceable with bionics such as our hearing, our sight, and even some simpler parts of our brain legendary thinkers [10].

Early applications of bionics were the cochlear implants to enhance our sense of sound, retinal implants to enhance our sense of sight, and skin implants to enhance our sense of touch. Bionics will not just serve as replacements for sensory systems but as upgrades for the human body parts with an enhancement for the human capabilities, it means that these bionics enable humans to hear frequencies below 50 Hz that a natural human ear is deaf to, or maybe it could also go above 20,000 Hz letting humans hear high-pitched noises like inaudible dog whistles, or integrating these ears with live transition wearables like the universal translators allowing the subject to hear real-time translation of foreign languages directly into their brain, breaking the world barrier of different languages and traveling the world without being held back by language barriers quite naturally. It is only a matter of time before these things become an add-on to our cochlear implants, the possibilities are astronomical and will subvert everything we have come to accept as reality [11].

Perhaps our vision will be improved as well, we can see more colors, better resolution, be able to visualize things like heat, identify different kinds of gases by sight alone, and even see through walls. Bionic lens is an implant designed to replace the natural lens of our eye giving us the promise of freely adjustable vision without laser eye surgery [12]. Over time, these bionic lenses could be upgraded to include additional functions like projecting your smartphone screen or even sharing your perspective with another person who also has a bionic lens installed, we could even send our visual data to others around the world, syncing it to the internet using a wireless 5G compatible system through these devices [13].

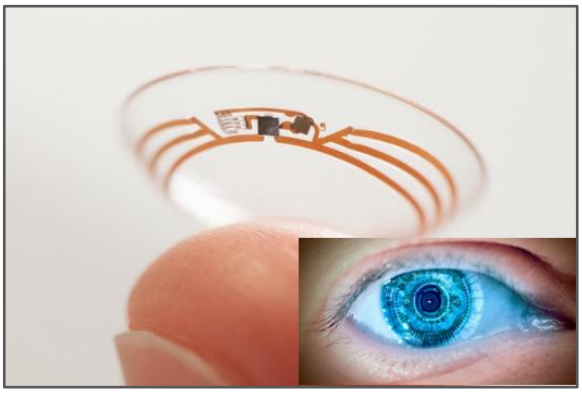

Figure 7. Bionic Lens

Bionic epidermis is a concept that technologists call artificial electronic skin or e-skin, the skin to replicate or even enhance our sense of touch. Scientists from the University of Colorado Boulder, USA have attempted to replicate the sensitivity, malleability, and durability of our skin as well as its sense of pressure, humidity, temperature, and air flow. Not only this new artificial skin is more robust than actual skin but also it is self-healing through the chemical bonding of polyamide in a multi compound ethanol mix. Potential for enhancement could be added, tiny sensors could be embedded to your prosthetic skin, it could one day be wirelessly connected to your car, your phone or even your house like some sort of giant wearable smart device[14].

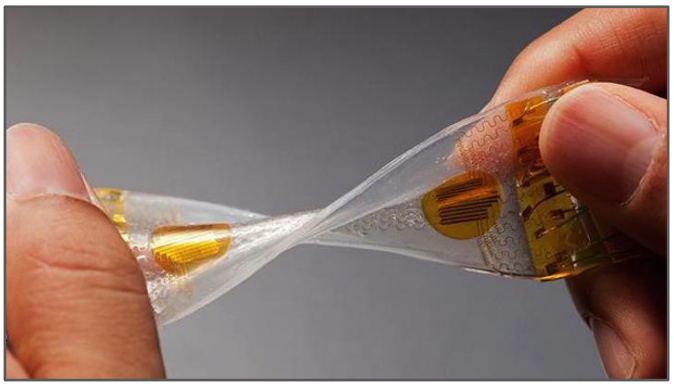

Figure 8. E-Skin

The bionic limbs are attached to the biological body via synthetic skins with stiffness variations that mirror the underlying tissue biomechanics. Bionics technology comprised of three extreme interfaces to the human body:

- Mechanical: how the limbs are attached to the biological body.
- Dynamic: how they move like flesh and bone.
- Electrical: how they communicate with the nervous system.

Hugh Herr, MIT professor, both of his legs were amputated due to tissue damage from frostbite, incurred during a mountain-climbing accident. He converted his disability to a great ability to change his life and others too. It begins with a mathematical model to figure out the geometries and locations of various tissues then do a mathematical transformation to the design of the synthetic skin; technology has proved that optimality where the body is stiff, the synthetic skin should be soft, and where the body is soft, the synthetic skin is stiff. Currently embedding sensing and smart materials into the synthetic skins under electrostatic effect, it changes its stiffness, offering a greater maneuverability over the bionic limb. It is also used with the exoskeleton to change between stiff and soft in just the right areas of the running cycle to protect the biological joints from high impacts and degradation. Figure 9 shows fundamentally how the bionic limb is controlled to model the missing biological limb, what reflexes occurred, how the reflexes of the spinal cord are controlling the muscles, and that capability is embedded in the chips of the bionic limb [15].

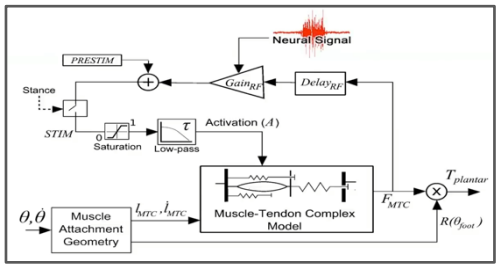

Figure 9. Bionic Limb Control Model

Bionics engineering can really challenge the disability through using a powered prosthetic that will feel more effortless than controlling it consciously, making it easier for amputees to adopt a powered prosthetics. Adrianne Haslet-Davis who lost her leg in Boston attack, USA, thought that her dancing career was over. A team of scientists with all kinds of expertise in prosthetics, robotics, machine learning, biomechanics, and a dancing professor have got together with one goal; a dancer with a powered prosthetics limb to dance again efficiently and flawlessly as she was with her biological limb. They studied how dancers move, what forces they apply on the dance floor, they took those data and they put forth fundamental principles of dance, reflexive dance capability, and they embedded that intelligence into the bionic limb. She performed dancing on the stage with her bionic leg exactly as it was when she had her biological leg [16].

Figure 10. Professor Hugh Herr and Adrianne Haslet-Davis, Powered Prosthetics Limb

VIII. NEURALINK

Just few years ago, biotech companies for BioBots invented a new technology "Biofabrication". They launched a desktop 3D printer, simply instead of plastic, a special ink is used combined with biomaterials like collagen and cultured cells to build a living tissue and human organs, they demonstrated the printing of a replica of Van Gogh's ear. Eventually we will have printable noses, lungs, kidneys, and it will be affordable financially and on-demand. A new era has begun, the era of "Transhumans" which means embedding machines directly into the human body [17].

Technology was able to decode DNA and even discovered methods to selectively edit it, technology has invented tiny devices that can be implanted into the human body to correct our heartbeat, take organs from donors and transfer them to those in need, perform total joint replacements, and artificially grow skin from stem cells[18].

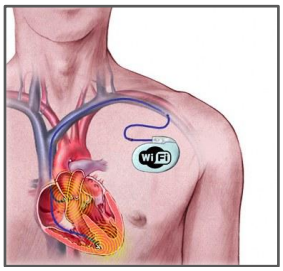

Figure 11. Traditional Telemetry Implants

Today, confidently we can say that the world's information is at our fingertips, however the bottleneck is the interface which is our fingers and the speech which they are too slow and a very low bandwidth form of communication between humans and advanced devices. A much faster way to get to this information would be directly to the brain, this is called the Brain-Machine Interface (BMI) and the Neuralink is an effort to solve this problem [19].

Over the last decade, Elon Musk has become one of the most famous men on the planet, revolutionizing the banking, automotive, rocket, and energy industries in a relatively short period of time. July, 2019, Elon Musk had a presentation detailing the Neuralink project, Neuralink is considered Musk's most fascinating venture yet with the goal of developing technologies to unearth the mysteries of the human's most vital organ; the brain, one of the final great frontiers of science.

Neuralink is a multidisciplinary effort, it includes scientists, doctors, electrical engineers, surgeons, and more. The brain consists of neurons firing all the time in response to electrical signals sent when we see, hear, move, talk, or think, and whenever a neuron fires from these electrical signals, a tiny electromagnetic field is present. Basically, Neuralink is going to tap into these tiny electromagnetic fields generated as a junction in the brain. It is going to interpret this analog data as ones and zeros to be used in the digital world [20]. The neuron pulses will be detected using tiny threads about one-tenth the cross section of a human hair or about the size of the neuron itself. Each thread is to be installed with a robot, so it is not going to burst blood vessels or cause trauma, the needle for insertion is 24 microns in diameter which is much smaller than the state-of-the-art in deep brain stimulation. The Neuralink contains thousands of electrodes, these electrodes need to be less than 60 microns away to detect a fire in the neuron and serve as the interface that reads data from the brain and sends data to the brain.

The processor for making all this to work is something called the N1 chip that reads analog brain signals, amplifies them, digitizes them, processes them, and then sends them out to a pot device behind the ear. The pod device is the only thing that is going to be upgraded occasionally and the implant stay as they are, in case of removing the pod, everything shuts off. The N1 chip is 4 by 5 millimeters, low-power, and has a built-in hardware for processing brain signals that it can read 20,000 brain samples per second[21].

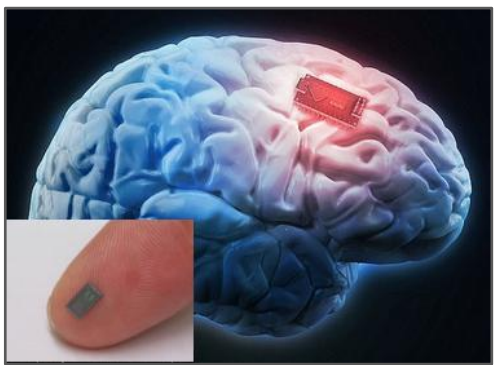

Figure 12. Neuralink N1 Chip

The Neuralink application with a significant Artificial Intelligence (AI) capabilities that will run on the cloud to connect to those pods bluetooth devices and then use your brain as a mouse or a keyboard for your phone or any other electronic device. Reality it won't be bluetooth because bluetooth does not have the capacity for the large amount of data to transfer[22].

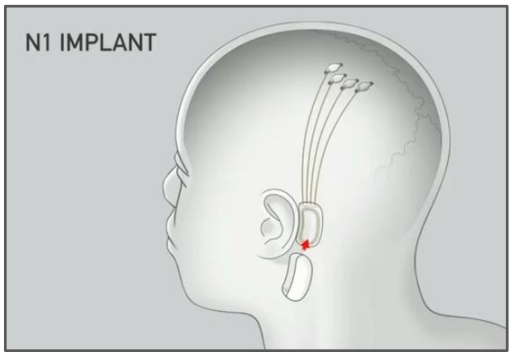

Figure 13. Neuralink Implants Communication

The future of Neuralink will be in three stages stage [23]:

- Stage # 1 is to understand and treat brain disorders starting with people with serious medical needs.
- Stage # 2 is to preserve and enhance one's own brain.
- Stage # 3 is full brain machine interfaces.

In the future that could even be a kind of app store for programs that you can download and control with your brain or other possibilities include a new kind of communication like telepathy or downloading the memories of someone, basically the possibilities are kind of endless.

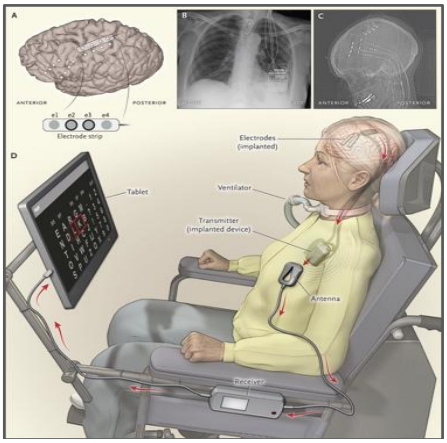

Figure 14. Direct Connect the Human Brain to Machine

This technology could help accelerate the exploration of the brain through basic understanding of how the nervous system works. It will help people with severe brain malfunctions and injuries to live happier and longer lives. It can actually just bypass the ear as a sensory organ altogether and artificially stimulate the nervous system to allow the deaf to hear.

When technology be able to fully map the brain, then we can begin to connect the mind to computers, telepathy, telekinesis, recording memories, photographing dreams, things that we see in the Hollywood movies will be true. Inserting memory back into the brain could sound as science fiction idea but think for a moment that it could really be used to cure illness such as Alzheimer, it could also be used for ethical purposes such as rehab programs.

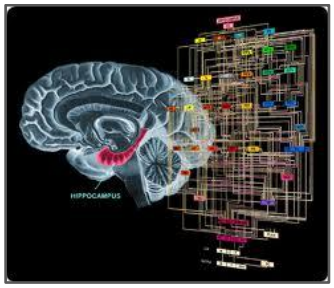

Figure 15. Human Brain Mapping

The technological future will make today's humans who are using a mouse with a computer or even screen touch like a stone age, because this technology will enable people who are paralyzed can mentally have mechanical arms and legs and live a life again, when you walk into a room you will mentally turn on the lights and television, mentally call your driverless autonomous car to take you where you want, to go without typing, talking, basically everything is communicated mentally.

IX. CONCLUSION

Our time is limited, if we are not making someone else's life better, we are wasting our time. Fact is, we did not waste our time, we humans worked effortlessly the last decade and combined technologies such as bionics, artificial intelligence, and faster communication that have evolved exponentially, we moved from implanting simple telemetric sensors for things like temperature, diabetes, and more to implanting things into our brains known as neurotech, this field of research is looking at how we can use things like neural memory implants as a cure for Alzheimer's disease, and how the AI can predict where body tremors caused by Parkinson's disease could occur.

Today's carbon fiber silicon and titanium prosthetics go much further and can now be made to look almost indistinguishable from the real thing, and those what is believed as enhancement are just as replacement. We clearly seem to have the beginnings of what could be considered bionic ears, bionic eyes, and bionic skin. It might just be the case that the evolution of our technology has come to play a greater role in guiding our species than our DNA has and if we can harness this power we can open up a new chapter in the storybook of humanity.

Scientist believes that we are the generation that will see physical disabilities disappear. It is expected in the future that the natural biological humans will make decisions to replace their body limbs with bionic limbs not because of an injury but to be able to do certain jobs or functions, basically voluntarily become a cyborg. This day will come when athletes beg to have voluntary amputations to make them better at their respective sport and when we upgrade our inferior limbs into a full-on bionic enhancement.

In conclusion, we are not there yet where we want to be, but remember very well, we must just move the ball forward, also we will find many that want the progress to fail but we also going to find many want us to succeed, just keep moving forward no matter what, and we will get it right at the end.

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