Today, most Canadians have access to more computing power than the most powerful governments 60 years ago. Though many people tend to take this fact for granted when they are complaining about how slowly their online video is loading, it is hard to argue the advancements in technology have not been wildly successful. With little struggle, an average person can easily contact a friend on the other side of the planet and receive an answer within seconds. This feat would have been considered inconceivable for a regular citizen but a few decades past. Science has reached new bounds with the ability to run millions of calculations in short periods, and will continue to increase as more and more advancements are made. Technology has settled itself nicely within all aspects of modern society; so much so many couldn't consider functioning without ~~out~~ it. Yet, despite the reliance and trust put into today's technology, nearly none of the population can describe how it functions. In fact, the majority of people don't know how this technology even came into existence.

interesting hook

well developed background

When looking through the history of modern technology, beyond the smart phones, computers, and circuit boards, one device has acted as the major catalyst which allowed society to jump into the digital age: the transistor. This little talked about device is the original building block of almost all of modern day technology. **Transistors have aided in the development of the majority of today's technology, created as well as innovated fields of academia and business, and continues to advance the human race as engineers continue to improve the essential device.** Without this relatively unknown component, computers wouldn't be close to their current size, state, and affordability. According to many researchers and analysts, the transistor is the single most important invention of the 20th century.

√focused thesis

To understand the impact of this mighty invention, one needs to have an idea of how computers work. One similar and well known analogy is that of the brain. In human brains, there consists billions and billions of nerve cells called neurons. These cells emit electrochemical signals allowing the host to think, move, and remember. When these signals are sent in different sequences, they can represent different feelings. One sequence might be the memory of the smell of peanut butter; another sequence could be the command to jump over a skipping rope. Each set of messages sent around the brain represents something different and unique, just like in a computer.

explaining the process

Rather than chemical signals, a computer uses switches which swap between an on and off state. These "ons" and "offs" (or ones and zeroes as they're referred to in computing) are the basis of computers. Just like neurons, a certain order of ones and zeroes will represent something unique. One sequence of ones and zeroes might be the letter "Q"; another set could be instructions on how to interpret a mouse click. If one was to put millions of these switches together, it even allows these simple on and off states to turn into something much larger, like an internet browser or video game. However, where brains have neurons to send, receive, and interpret these signals, computers need switches. As physical switches were exceptionally impractical to use, the stage was set for a new switch that could be controlled solely by electronics.

history of developm

The first substitute for electrical switches was the vacuum tube. This device's original purpose was to amplify radio and is a surprisingly well known invention, being a variation of the light bulb invented by Thomas Edison. Though this filled the void and allowed for computing to exist, another issue

arose quickly after. More computational power required more vacuum tubes, and it is obvious a computer filled with components the size of light bulbs would be quite large. "In the late 1940's, big computers were built with over 10,000 vacuum tubes and occupied over 93 square meters of space," (Haviland, 2002, para. 8) just to satisfy the government needs. On top of that, vacuum tubes would leak, could have the metal inside could burn out, required too much power for big circuits, and could be shut off by something as simple as a moth's interference. Vacuum tubes weren't going to be enough if computing was to flourish, and once again the scramble for a new invention continued.

On December 23, 1947 "after 18 months of work John Bardeen and Walter Brattain working under William Shockley [showed] off the first transistor to bosses at Bell Labs," (Building the digital age, 2007, para. 4), marking the beginning of the transistor revolution. The transistor was everything the vacuum tube wasn't; it was efficient, generated little heat, and consistently switched between states. This wasn't to say it was without its own flaws. "The first transistor was about the size of the palm of a hand, with a depth of two matchbooks stacked on top of each other," (Gaudin, 2007, p. 1), meaning it wasn't quite ready for the consumers. Yet sure enough, the invention spurred on a highly funded research effort. By 1953, the first commercial transistor product was released: a hearing aid. Suddenly, this little piece of technology which had only excited physicists and engineers was able to return hearing to someone who was near deaf. More importantly for the consumer, these new devices were affordable and accessible. The practicality of such an invention wasn't lost on the public, and soon enough, transistor powered products were appearing on shelves (and being bought just as quickly) of any store that was able to put them in stock.

history

The creation of the transistor had an immediate impact on the world's technological and economic fields. The United States incorporated the transistor into their telephone network and soon after the development of the "hearing aid from Sonotone, [it was] rapidly followed by handheld transistor radios," (Building the digital age, 2007, para. 8). Most importantly, the world's first transistor computer was created, laying the foundation for the birth of the computing industry. This directly lead to the beginnings of Silicon Valley—so named as silicon was the defining metal in a transistor—which would go on to birth world renowned companies such as Intel, Microsoft, Facebook, Google, and Apple. The industry maintained its extreme level of growth and was "worth more than 100 million for the first time," (Building the digital age, 2007, para. 15) in the year 1957. Only seven years later, it was worth one billion dollars and today as society becomes increasingly reliant on all forms of technology, this number continues to climb.

initial Impact

The next big development the tech industry would undergo would be the creation of the integrated circuit. Though they have a very technical name, all these IC chips consisted of were massive amounts of transistors packed into a very small space. This solved the final problem computer scientists had been plagued with since the time of vacuum tubes: the issue of size. Today, these chips found inside every computer can "incorporate 731 million transistors (and numerous other components) on a single 263mm^2" (Computer History 101, 2011, p. 2) area which is about the size of a loonie. When they were first developed, IC`s obviously weren't nearly as compact, but they did lead into the creation of the first personal computers. What might have taken a three stories of machines in the 1940`s could now be condensed into one small device that could fit into anybody`s home office. This invention's significance

Secondary Impact

on business, technology, culture, and many more fields cannot be overstated and it was due to the development of the transistor that this product allowed the world to thrive in the current digital age.

As home computers became more and more widespread, the idea of a network of computers had started to develop. As more transistors were compacted into smaller IC chips, servers could now be created with enough computing power to host a significant amount of information. When these servers were combined with the consistently growing number of personal computers that were being purchased, the first seeds of the internet were planted. The motivation of the creators of the internet was originally quite mundane with it being "envisioned as supporting a range of functions from file sharing . . . to resource sharing and collaboration, and has spawned electronic mail and more recently the World Wide Web," (Cerf, 1996, section. History of the Future). This creation gave anyone who owned a computer access to an unprecedented amount of information and communication. However, even though the contribution of the Internet to today's society may go unchallenged, some claim the transistors impact is minimal in contrast. Naysayers state the internet has developed into its own entity, and is no longer affected by the state of transistors. Yet, according to experts, "the Internet is a creature of the computer [and] it will, indeed it must, continue to change and evolve at the speed of the computer industry if it is to remain relevant," (Cerf, 1996, section. History of the Future). Therefore, both creations have and will continue to benefit from each other's existence for many years to come.

Unlike other famous inventions of the past, the peak of the transistor's career was not at its conception. In 1965, Intel founder Gordon Moore predicted "that the number of transistors on a chip will double every year," (Building the digital age, 2007, para. 19). Though he would later revise his statement to every two years instead, this comment was proclaimed as Moore's Law and has acted as a self-fulfilling prophecy right up to the current date. The development of transistors has pushed the edges of science the entire time they've existed; but now as transistors approach fundamental physical size limits, breakthroughs in engineering are necessary to crawl closer to perfection. The current solution is to use the transistors more efficiently through supercomputers. Supercomputers are being created across the globe, with China's Tianhe-2 being "the world's top system [capable of] achieving quadrillions of calculations per second," (Carter, 2014, p. 1). Unfortunately, supercomputers take a lot of room and require extreme cooling making them impractical for regular users. Another solution to the size issue is to simply use something smaller such as carbon nanotube transistors. These transistors are "tiny cylinders made of rolled-up, atom thick sheets of carbon," (Orcutt, 2015, para. 2) and could one day replace the normal transistor. No matter what the answer is to the looming question, the transistor continues to drive both the computing industry and multiple fields of science toward the future.

Looking to the future

The transistor is undoubtedly one of the smallest inventions that has had one of the most meaningful impacts. It has allowed for the creation of modern day computers which have had an unfathomable impact on culture and society. The transistor paved the pathway for Silicon Valley, creating multi-billion dollar companies and boosting economic industries globally. Lastly, as time continues forward, innovations will continue to be made on the mighty transistor which will further improve quality of life around the planet. Overall, the transistor is well deserving of its lengthy legacy, and stands as a top contender for the greatest invention of the 20th century.

Conclusion

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