

Research report – transistors

Business



Overview A transistor is a semiconductor device that amplifies and switches electrical currents. They are the core component of any modern electronic devices, such as computer, telephones and other electronics.

Nowadays most transistors are use to produce integrated circuits. There were a numerous inventions, or problems with the inventions that lead to the birth of the transistor. Radio signals, could be sent carrying information over a long distance away; the only problem was there was no device to receive the signal.

This was solved with a rectifying vacuum tube, invented by John Ambrose Fleming. The vacuum tube was added a new component to become an amplifying vacuum tube.

Lee De Forest who was an American, invented this amplifying vacuum tube by adding a third electrode, called a grid. The grid's negative potential controlled the flow of electrons from the cathode to the anode. The lower the negative potential of the grid, the more electrons it allowed to flow through the tube, hence producing an amplified current.

This amplifying vacuum tube allowed many new electronic inventions in the early 1900s; such as radios, telephone equipment, televisions and computers. However, size and reliability was a problem with vacuum tubes.

For example, the first general-purpose electronic computer, ENIAC, had approximately 18, 000 vacuum tubes, which occupied several large rooms and required so much power that could light ten homes. The vacuum tube

generates large amounts of heat in order to boil out electrons and often burned out after thousands hours of use.

In the case of ENIAC, several tubes burned out almost every two days, leaving it non-functional about half the time. For applications requiring thousands of tubes or switches, such as the nationwide telephone systems developing around the world in the 1940s and the first electronic digital computers, such as the ENIAC mentioned above, this meant constant vigilance was needed to minimize the inevitable breakdowns. In the 1930s, Executives at Bell Labs recognized that a better device was needed for the telephone business to continue to grow.

They acknowledged that an alternative to the vacuum tube amplifier and electromechanical switches, which are employed throughout the nationwide Bell telephone service, may lie in the special class of metals – semiconductors. Eventually a team of scientists at Bell Labs had created the transistor. The transistor showed to be a practical alternative to the vacuum tube and, by the late 1950s, replaced the vacuum tubes in many applications. Its many advantages listed in table 1 made the miniaturization of complex circuitry possible. During the 1960s and 70s, transistors were incorporated into integrated circuits.

Table 1. Advantages of Transistor over Vacuum Tubes. Advantages •Small in size, this allows the development of miniaturized electronic devices. •Mostly automated manufacturing processes, extremely low cost to produce •No heating-up process required for vacuum tubes •Minimal power is required

which equals more energy efficient. •Extremely reliable, rugged. •Long operating life.

Contributions of each of the 3 main scientists involved in the development of the transistor The invention of the transistor in 1947 was the success of 3 top-class scientists, John Bardeen, Walter H.

Brattain, and William B. Shockley, at the American Telephone and Telegraph Company's Bell Laboratories. In 1936, William B. Shockley was recruited into Bell Laboratories.

He sketched amplifier ideas using copper-oxide semiconductor as a basis to make diodes. Experimental physicist, Walter H. Brattain, assisted Shockley in producing a prototype in 1939, but it failed entirely. Semiconductor theory could not yet explain what was happening to electrons between copper and its oxide.

With limited theoretical understanding, manipulating the correct composition of these semiconductor materials was a problem, which were two combinations of different elements, in this case copper and oxygen.

After the end of World War II, Bell Labs was reorganized and a new solid-state research group was set up, having Shockley as the leader of the group. The pursuit of a solid-state amplifier started in April 1945; Shockley suggested a field-effect amplifier based on semiconductors. He reasoned that a strong electrical field would cause the flow of electricity within a nearby semiconductor.

His device was a small cylinder coated thinly with silicon, set closely to a small, metal plate. University of Illinois Electrical Engineer Nick Holonyak described it as “ a crazy idea”.

Indeed, attempts to produce such a device again failed completely. In March 1946, Shockley had hired John Bardeen, a theoretical physicist, to join the solid-state research group to. Shockley assigned Bardeen and Brattain on a task to find out why. According to author Joel Shurkin, “ the two largely worked unsupervised; Shockley spent most of his time working alone at home. Bardeen, the theoretician, suggested experiments and interpreted the results, while Brattain build and ran the experiments.

Bardeen proposed a likely justification; the effect of the electrical field was perchance blocked by electrons on the semiconductor surface, therefore, the conductivity was left undisturbed. Bardeen’s hypothesis prompted a research into these ‘ surface-state’ electrons. While investigating this phenomenon in November 1947, Brattain discovered a method to deactivate their blocking effect and allowed the electric field to penetrate into the semiconductor material. Over the next month, and the effort had payed off.

On December 16, 1947, Bardeen and Brattain invented the first semiconductor amplifier, called a point-contact transistor. The device, shown in diagram 1, had two closely spaced gold foil strips on a plastic triangle jabbed into the surface of germanium which sat on a metal plate attached to a voltage source.

The input current (the emitter) changes the conductivity of the semiconductor, thus varying the output current out the second contact (the

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collector), effectively amplifying it. When Bardeen and Brattain contacted Shockley to tell him of the wonderful invention, Shockley was pleased at the results.

Shockley called this invention a “ magnificent Christmas present”. Shockley was also furious that he had not been directly involved; he was not told about the changes they had made to the experiments. Shockley and his competitive spirit was determined to make a better amplifier. Another trigger to Shockley’s determination was that the Point-contact transistor, being the first transistor invented, had not gone as well as hoped. Manufacturing them reliably and with uniform operating characteristics was a major problem.

As a result, it faced a difficult growth period and it was eventually used only in a switch made for the Bell telephone system. A burst of anger and creativity allowed Shockley to envision another way to produce a semiconductor amplifier. His device, the junction transistor was basically a three-layer sandwich of germanium or silicon in which the adjacent layers would be doped with different impurities to induce distinct electrical characteristics. An input signal entering the middle layer determined how much current flowed from one end of the device to the other under the influence of an applied voltage.

Shockley spent a total of four weeks working pen on paper, it took another three years until a working one was actually built.

His device was tougher and more practical than the point-contact transistor, and much easier to manufacture. The junction transistor eventually became the central artifact of all the electronics. Author Michael Riordan said <https://assignbuster.com/research-report-transistors/>

Bardeen and Brattain got “ pushed aside. ” That insult turned a once cooperative environment into a highly competitive one. Bell Labs publicized the triumphant invention and development of the junction transistor in July 1951; this time, only Shockley was mentioned.

Though many scientists contributed; it was three physicists who really invented the transistor, John Bardeen, Walter H. Brattain, and William B. Shockley. The three men each had unique skills which, initially, created a brilliant research and development team. The theoretical physicist John Bardeen was the thinker, he could comprehend and interpret results and explain them beyond common understanding. Experimental physicist Walter Brattain was the one who was always in the laboratories, being known as the tinkerer, he was a builder who could build or fix just about any device asked.

Theoretician William Shockley was the visionary; who envisage how important the transistor would be long before anyone else. All three of them were the finest scientists; and their diverse skills had made the invention of the transistor possible. Assess the impact of the invention of transistors on society with particular reference to their use in microchips and microprocessors Transistors had lead to the possibility of many electronic applications, engineers were unable to put the large number of components into one small package, which is required for complex devices to be portable.

And in 1959, a huge breakthrough took place with the invention of the integrated circuit (or microchip), which is the ability to organize numerous transistors and other electronic components on a silicon wafer, complete

with wiring. Thus the evolution of the Information Age was taken to the next level with these microchips.

It is obvious that the impact of integrated circuits have on our lives is momentous. Modern computing, communications, manufacturing and transport systems, including the Internet, all depend on the existence of integrated circuits.

Integrated Circuits are the main component of most of all electronic devices. ICs are popular due to their low cost, reliability, low power consumption, and high processing speeds compared to vacuum tubes and transistors.

Computers, mobile phones, and other digital appliances are now inextricable parts of the structure of modern societies. Without Integrated circuits, modern communications would not be possible.

Computer (electronic mail, instant messaging programs) and mobile phone plays an essential role in instituting modern communications, the ease of communication certainly is beneficial to society.

It has:

- Enabled us to alert people of illness injuries more quickly so more lives could be saved.
- Facilitated the rapid exchange of information, speeding up the pace of business, government, and scientific and technological advancement.
- Spread word of wars and disasters faster, promoting a more global focus in people's lives.
- Permitted family members to live farther apart while continuing to share in each other's daily lives

It is obvious that Internet alone has a huge impact on society; Internet creates new ways for people to communicate, collaborate, and share information as a community.

Internet has and will continue to have an impact on different areas of society, such as media, education, health care and businesses.

The following is a negative impact of Internet on the media and the general public. In the era of 24-hour media coverage, the internet is no doubt the lifeline for journalists in their never-ending rush to report a breaking news story in time. While the Internet has made research easier and more convenient, information shown on the Internet is not always correct.

Misleading information can be easily posted on the Internet without the need of approval.

A rather interesting news recently demonstrated this, after the death of the French composer Maurice Jarre was reported, 22-year old sociology student Shane Fitzgerald from University College Dublin put a totally fake quote on Wikipedia, a free online encyclopedia that anyone with internet access can make changes to any of its articles.

Within a few days, newspapers in England, India, America and as far away as Australia had Shane Fitzgerald's fake quote in their reports of Jarre's death. This was revealed a few weeks later by no other than Shane Fitzgerald himself. This shows just how reliant reporters are on the World Wide Web.

If a 22-year old student can so easily falsify the news around the world, even to this small degree, then it is unnerving to think about what other false information may be reported in the media. In the field of education, Internet has changed the way students study, do research, and where we get other information. Students no longer limit their study purely on books, as a limitless amount of information and ideas is readily available on the internet.

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Scholars can easily increase their knowledge on any subject from instructions to building anything to history on space exploration.

In the medical field, the integrated circuit has direct impact on the advances. The microchip helps the deaf to hear by the invention of a hearing aid device. It is also the core of many medical diagnostic machines. Another impact is the research capabilities it offers to the general public.

With the infinite knowledge accessible on the Internet, individuals can gather valuable sources of information. The patient is much better informed to discuss his case with his doctor, consider options, identify side effects, the most recent treatments available and the statistical probabilities of success.

The Internet also allows collaborations of researchers and scientists working on diverse areas such as neurological diseases, speeding up the pace of medical advancement. Also telemedicine allows medical specialists in Perth to diagnose and treat patients in Sydney. In the end, it all concludes to that society now lives longer, with the help of the internet, which is made only possible with the use of integrated circuit.

The way people conduct business has changed greatly with the extensive use of the Internet. A term – e-commerce is evolved, which consists of the buying and selling of products or services over the Internet.

The internet enables companies to sell products and services with little expenses. This generates large sums of revenue for businesses which promotes research and development of new products which will improve

society's standard of living. Integrated Circuits had huge impact on modern society's leisure.

The invention of the transistor led to the invention of electrical appliances, such as cloth washing machine, disk washer, and many other labour savings devices. This had impacted on the society as to that the general public have much more free time to do other things.