Essay about the articles of Bush and Licklider by Manuel Naujoks

1   Abstract

Vannevar Bush wrote his article "As we May Think" [Bus45] in July 1945. J. C. R. Licklider wrote the article "Man-Computer Symbiosis" [JCR60] in 1960 and "The Computer as a Communication Device" [JCR68] in 1968. Both persons had great ideas of how the computing devices can help humanity. The following will give an overview about what those people wrote and how those ideas already had or will have an impact on the way we deal with information and knowledge in general.

2   As we May Think

Bush starts his article with the question how science in general helped men and which benefits did it create for him. He answers that question by giving examples of improved food and health care as well as extended knowledge of his physiological and psychological functions. This makes men wonder how far they can go and how far life can be changed for better by pursuing the continuous science goals. Life got better through science, but it can still be improved especially concerning information and knowledge. Bush thought that the way we published and use information is not efficient enough. Therefore he introduced gadgets that could improve information recording. In his example a scientist records his whole day with effective cameras. Today, this idea totally came true, like all the public science footage proves. Not only recording is important. The storage and accessibility is also necessary. To provide all the recorded knowledge on demand, it needs to be compressed and stored flexible. Bush elaborates his thoughts concerning this aspect. He wrote that if all the books and all the written material of the world could be compressed, it would fit into a single van. Modern hard drives are capable of storing huge amounts of data and are getting cheaper. Information is piling up more and more so that storing technology needs to improve continuously with the at least the same relative speed. Bush further describes how the stored information can be accessed. He writes about machines that are capable of speaking and listening and grant humanity with advanced interoperability. Those machines can be talked to, to read all the stored information. Today computers are able to react on voice and to read text. In future that technology will become more advanced. That will result in comprehensive systems that are capable of assisting men way better than current computers can do. Besides that Bush prophesies that arithmetical machines will be at least 100 times faster in the future. He claims that this is necessary to relief scientists and to free their brains for more important stuff than manipulation of mathematics. Considering modern processors and Moore's law, this trend reaches far beyond factors like 100. Bush writes about a personal computer that makes it very easy to access all the data that he or other people recorded. The device he is writing about is called "Memex" and allows the user to link information together to create semantic information chains. Bush said that the process of tying two items together is the important thing. He then describes a technique that uses code words. The data and its meta-data then can be published so that other people might use that. He further describes all kinds of businesses that take advantage of the new information machine that contains all the worlds' knowledge. Today, considering Wikipedia.org, Bush's idea came true. People can tie information together by linking from keywords of articles to other articles. Everybody can contribute to this giant source of prepared and ready to use knowledge to create more and more information chains. In future the internet will follow this path which introduces the semantic web to provide men more efficiently with the knowledge and information he is looking for. Currently information chains in Wikipedia are online and therefore available for everybody. Creating private chains might be possible as well soon. At the end of Bush's article he writes about how the men-machine interface could be extended. Therefore he describes that for example the human brain can be wired to computers. There are two directions possible. Scientists nowadays are able to move a pointer on a computer screen just by thoughts. Other experiments on rats showed that their brain can kind of be remote controlled. Special currents in the brain led the rat to directions the scientists want it to. There is some risk at this aspect because the human brain is still a very complex and sensitive organ that is better not messed with. Thinking of all these ideas, humanity can take big advantages of how information and knowledge can be recorded, processed and accessed.

3   Man-Computer Symbiosis

Licklider wrote about the symbiosis of man and computer in his article. Like Bush he explains that it would be very helpful for men if computers can be used to support humanity and to release people from doing time needing operations. At the beginning of the article he writes about how people used machines to extend their capabilities. Licklider said that this is not the symbiosis he meant. In his meaning men live together with self-sufficient computers and build a cooperative partnership with those machines. Computers therefore will have some kind of intelligence. Artificial intelligence will become an important part of humanity to deal with tons of information. Current approaches are very limited and make machines capable of solving just specific problems. As computers get more versatile, they might be able someday to have their own formal thoughts. Then they can be men's partner in all kinds of businesses, especially to analyze information. Those intelligent machines will be able to learn

from men and from the world's knowledge to make more comprehensive decisions and to create additional knowledge as a consequence. Licklider describes how a direct cooperation between both sides could look like. Men would delegate time needing operations that can be performed efficiently by computers to them and could spend their own time on thinking through processes or grasping computer provided information. Humanity would specify the requirements and the boundaries to mark the thread on which the machine can finally operate. Besides that men could handle situations of low probability that usually do not arise. After the computer finished the calculation of the current operation, the result can be used and combined with the result of the operator to composite a comprehensive solution for the problem or a decision. It is interesting that Licklider refers to computers as "information-processing equipment". The obstacles of such a symbiosis are for example the language both sides use. So that machines can be made capable of understanding human intensions, the way how information and knowledge is conveyed needs to change. According to Licklider, instructions directed to computers need to be related to how the operation can be performed. Humans usually specify just the goals as they exchange information. Today we have high level programming languages and compiler that allow us to specify actions to computers very well. Though, this requires a programmer and lots of time. So the programmer might not be the future way to communicate with machines. Therefore Licklider introduces several input and output concepts. The most effective is the speech production and recognition, which were also elaborated in Bush's article. Today there are systems available that react on speech and that are able to read information. If this technology improves, computers can be talked to and they understand not only the words but the meaning of them. There should not be a need for a special language because such systems should be used by everybody and not only by "oral programmers". Licklider mentioned the military commander and its need for fast decisions. Other ways of communicating with machines are less effective because they need input of the physical kind but would work in a noisy environment as well. If those concepts could be combined, a system that can easily be worked with will emerge.

4   The Computer as a Communication Device

In this article Licklider writes about how computers could be used for communication purpose. He introduces multi-access computers to do better presentations and collaboration. For example the audiences would see what the speaker is talking about on personal screens and have the opportunity to communicate with each other or to see additional information of previous slides. Such technology exists today, speaking of several Microsoft® products. Licklider wrote further that many computers could therefore be integrated into a network to use programs, information and knowledge of other computers as well. This network can then expand to a network of computers from all over the world, the internet. According to Licklider such a network can be used to work and to access knowledge from everywhere in the world with just a computer terminal. But not only will those computers be wired to the world wide network. Every data-gathering or information-using device will be connected to create a comprehensive information and communication linkage. All that network content could then be used from those devices as well. Current trends integrate mobile phones into that network to enable business processes in every situation. Considering the ideas of Bush, the knowledge of the whole world could then be accessible everywhere and every time. The only concerns that Licklider has are related to the way connections are provided by carriers. The costs of the transmission of data could be expensive which might exclude some people from being connected. Besides that Licklider writes about a concept called "OLIVER", which is kind of an individual and personal representative of one in the internet. For example this program will answer requests for conversations accordingly based on information about who the requested person's friends are. This will give the world wide network a social perspective that we might compare to social networking platforms on the web nowadays. He predicted that the internet changes the world of knowledge and information dramatically as the stuff is available all the time. It is increasing as well because all the people in the world can contribute to that source of knowledge.

5   Summary

Licklider and Bush wrote about computers in the future and how they can contribute to men's progress in science and everyday life. Bush introduced the ability of computers to record and store information in compressed format, to publish them with meta-data and to access them whenever it is needed. Licklider saw the computer as an intelligent and helping machine that can live in symbiosis with men. Men can use those machines to support decision-making processes and to do highly complicated math. Such relief could help humanity to focus on more important topics. Both, Licklider and Bush wrote about the human-machine interface. Bush mentioned the way of wiring the human brain directly to the computer while Licklider elaborates more subtle ways of input and output. Finally the machines can be connected to all the other computers in the world. That makes them communication devices which can be used to access knowledge and services of other computers in that network. Today's technology appears to be very close to those predictions. In future we might experience even more closeness and maybe new and additional ways of working with information and knowledge in the world.

6 References

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