CRITICAL ANALYSIS OF UBIQUITOUS COMPUTING BASED ON MARTIN HEIDEGGER'S NOTIONS OF WORLD AND TECHNOLOGY

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Abstract

The development of modern technology, in particular information and communication technology has caused the relationship between mankind and reality to fundamentally change. Ubiquitous computing designates a vision of an informationalized world, in which everyday objects are modified through computer technology such as RFID, sensors and sensor systems, tracking systems, or small computer units, giving them additional information or functions and integrating them with their environment. This paper explores the phenomenon of ubiquitous computing by applying some of the key concepts found in the philosophical works of Martin Heidegger and conducts a critical analysis using Martin Heidegger's reflections on "world" and "technology" from Sein und Zeit (Being and Time) of 1957, and from the paper "Die Frage nach der Technik" ("The Question Concerning Technology"). The concept of "Ge-stell" introduced by Martin Heidegger to the philosophy of technology describes the situation of mankind and technology in a world shaped by modern technology. Both, mankind and technology, are tied together within the same world. The world has been shaped and redesigned by technology, and the individual is completely tied into the technologized world.

Keywords: Martin Heidegger, Ubiqouitous Computing, Philosophy of Technology, Beeing-in-the-World

Introduction

Modern technologies have been shaping and transforming the world and the daily lives of individuals for centuries. Technologies such as power generation, the automobile, or the telephone have become an integral part of human life and determine our every move.

Since the invention of computers, and personal computers in particular, information and communication technologies have been among the key technologies of our time. Within a mere two decades, they have spread to such an extent that our age is frequently called the information age. The creation of the Internet, resulting in the interconnectedness of computers and software programs that had hitherto operated in isolation, and even more so the development of the World Wide Web (i.e., the graphic user interface of the Internet developed in 1989), have further accelerated this trend. The ongoing development, dissemination, and integration of information technologies, and the content that is stored by them, is growing daily. For instance, every minute some 100 hours of video content are uploaded to the Internet platform YouTube, and the number of visitors it attracts has grown by 200 million in as little as two years (http://www.youtube.com/yt/press/statistics.html).

A relatively new phase in the development of information and communication technology is the evolution of the Internet, i.e., the integration of computers based on standardized Internet protocols (IPs) to form the "Internet of things". This involves the upgrading of everyday objects by the addition of an IT dimension, and their integration with each other. Information technologies such as radio frequency identification systems (RFIDs), sensors, or localization systems transform and interlink everyday items and connect them to human beings with the help of computers and mobile end devices.

Specialist IT literature often refers to this "informatization" of everyday objects and everyday life as "ubiquitous computing".

This paper explores the phenomenon of ubiquitous computing by applying some of the key concepts found in the philosophical works of Martin Heidegger. It attempts to define the nature of this phenomenon and conducts a critical analysis using Martin Heidegger's reflections on "world" and "technology" from his mean oeuvre Sein und Zeit (Being and Time) of 1957, and from a text published in 1927 entitled "Die Frage nach der Technik" ("The Question Concerning Technology"). Part 2 describes the essential features, functions, and technologies of ubiquitous computing. Part 3 explores Heidegger's analysis of "Dasein" (literally "Being-there", referring to the human existence) in Being and Time by focusing on his description of "Dasein" as "In-der-Welt-sein" (being-in-the-world) and on the way that "Dasein" deals with everyday things. Part 4 examines modern technology from the perspective of the philosophy of technology that Martin Heidegger developed in "The Question Concerning Technology"; it also takes a look at Heidegger's criticism of calculative thought ("berechnendes Denken") as well as his technological analyses. Part 5 finally returns to various analyses discussed in the previous sections and analyzes the

phenomenon of ubiquitous computing based on Heidegger's essential determination of the nature of modern technology and the developed concepts.

Ubiquitous Computing: The Informatization of Everyday Life
From the Integration of Computers to the Integration of Things

Since the 1950s, information technology has developed and spread in four decisive phases (Christ, Fleisch 2003).

The first phase of the development of information technology was dominated by the arrival of mainframe systems, to which only a small number of users had access. These mainframe systems carried out individual calculations based on data entered by experts. They were usually stand-alone systems unconnected to other computers, and their operation required in-depth computer knowledge. As a rule, it took several computer experts to operate one mainframe system.

In the second key phase of the informatization process, which started in the 1980s, so-called personal computers (PCs) were developed for people's personal use. PCs caught on quickly and were soon widely used by businesses, public bodies, and research institutions, as well as private individuals. In most cases, one PC was assigned to one user or operator.

In the third phase of the informatization process, PCs and mainframes became integrated, forming the Internet as it exists today. Users of PCs and mainframes were able to exchange data using standardized, generally available transmission protocols, communicate with each other by means of software programs installed on their computers, and jointly utilize data and functions via the network formed by the computer systems. The graphical user interface of the Internet, which was developed in the 1990s, made it easier to use computer networks and, as a result, information technologies became more and more ubiquitous.

The fourth phase of the informatization process, finally, consists of the integration of everyday things with each other as well as with the Internet. Modern information and communication technologies are transforming everyday objects such as toothbrushes, food (packaging), or clothing into technical devices that can be linked with each other. The "Internet of computers" is becoming the "Internet of things", with things seeming to communicate with each other as well as with the Internet, and indeed with the users of the things themselves.

The term "ubiquitous computing" was first used in 1991 by Mark Weiser, who, in an article entitled "The Computer for the 21st Century" (Weiser 1991), described his vision of computers, omnipresent yet inconspicuous, i.e. not appearing to be computers or information technology at all, which support human beings in coping with their daily lives. For Mark

Weiser, technology is a means to achieve human objectives. He predicts the disappearance of the computer as a visible device and forecasts its replacement by the general availability of IT functions (Mattern 2003).

The following section provides a brief outline of the basic technologies of ubiquitous computing and examines in more detail how they work.

The Technologies of Ubiquitous Computing

Ubiquitous computing, meaning the idea of modifying and integrating everyday things by means of information technology, involves a number of basic technologies, thus drawing on different IT functions. Key functions in this context include identification, localization, communication, and measurement of the characteristics of things or their environment (Fleisch, Mattern 2005, Mattern 2013).

The **identification** of an object can be achieved through various technologies. Most ubiquitous computing applications use RFID systems. They consist of a transponder, which is either integrated into the object or separately attached to it, and a reader to scan in the object's identification number, allowing it to be connected with other information, or other information systems. Alternative identification technologies include image recognition by means of a camera or video camera, as well as the, by now also ubiquitous, barcodes (Fleisch, Thiesse 2008).

The **localization** of an object mostly takes place via a global positioning system (GPS). To enable it to be tracked, an object needs to have a GPS transmitter through which its exact location can be pinpointed and transmitted.

Communication uses common communication protocols or communication infrastructures such as a wireless local area network (W-Lan), bluetooth, or a mobile phone network. Transponders attached to some objects, or directly integrated into others, automatically assume a communicator function by sending data to other objects or, via a network gateway, to the Internet.

Information about the **characteristics of things and their environment**, such as temperature, humidity, or the velocity of an object, are measured by sensors attached to these objects or situated nearby, and transmitted via a communication connection.

In addition to the micro-technological developments of ubiquitous computing, there are also new technologies used in materials science. These can be said to cloak a computer, allowing it to completely blend into the environment (Langheinrich, Mattern 2003).

The four basic technologies of ubiquitous computing can be used individually or in combination. They can also be developed into integrated

systems which support all functions as a single unit. What all the technological approaches to ubiquitous computing have in common is the fact that they add an IT dimension to objects and describe things, or some characteristics of things, using data structures and mathematical procedures.

Martin Heidegger's Notion of World
"Dasein" as Being-in-the-World

In his major work "Sein und Zeit" (Heidegger 1977), published in 1927, Martin Heidegger developed a procedure to analyze the human existence or being, for which he chose the term "Dasein". According to Heidegger, being-in-the world, and therefore also the world itself, should, from the perspective of average everyday existence, be the focus of analysis as the next manifestation of the "Dasein". He felt that everyday being-in-the-world had to be examined, and that in a phenomenological approach to it, something like "world" had to be taken into consideration (Heidegger 1977: 66).

Martin Heidegger describes the relationship between subject and object not as bipolar, opposing entities but as belonging together. The "world of things" and his concept of "Dasein" are, according to Heidegger, not separated from each other and reflectively opposed, but they have always been connected because their meanings are related. Through the concept of being-in-the world, Heidegger tries to place the relationship of subject and object within a frame of reference from the everyday situation of "Dasein".

He sees the phenomenological demonstration of what we usually encounter as following the guidelines of an ordinary being-in-the-world, which we also call "dealing with the world" and "dealing with the inner-worldly being" (Heidegger 1977: 65-66).

Things become experienceable in, and because of, their significance and interconnectivity as a frame of reference for the "Dasein"; thus, they become world-forming within their habitual structures and behaviors. As Heidegger put it, these references are embedded in themselves as original wholeness; they are what they are, as this meaning ("Be-deuten") in which "Dasein" gives itself advance notice of its being-in-the-world. The frame of reference for this meaning is called meaningfulness ("Bedeutsamkeit"). This is what constitutes the structure of the world, i.e., that which "Dasein" as such is already (Heidegger 1977: 87).

The network of meaning in which the things and the "Dasein" have been placed, is described using the term "world", and the location of "Dasein" within the world is defined as being-in-the-world. "Dasein", i.e. the individual, is always already situated in the world of things, connected by their meaning (their meaningfulness). According to Heidegger, "world" in all that is ready-to-hand ("zuhanden") is always already "there". The world,

although not in so many words, has already been discovered, with everything that is encountered (Heidegger 1977: 83).

Later in the text, Heidegger focuses more explicitly on being-in-the-world by discussing the relationship between "Dasein" and "things"; he clearly distinguishes between the "Zuhandenheit" (handiness) and the "Vorhandenheit" (presence-at-hand) of things for the "Dasein", which the following section will go into in more detail.

The Relationship of "Dasein" to Things

In Sein und Zeit, Martin Heidegger criticizes the term "thing" and its inexplicitly premature ontological characteristics (Heidegger 1977: 67).

Instead, Heidegger uses the term "Zeug" (equipment) to refer to the things of everyday life. All things that human existence is concerned with, are therefore considered as equipment. To refer to how human existence deals in a habitual and non-observing manner with equipment, Heidegger coined the term "Zuhandenheit" (handiness): the nature of equipment as it reveals itself through itself. As he saw it, only because equipment has this innate "An-sich-sein" (being-in-itself) and is not simply there, it is handy in the broad sense of the term, and therefore employable (Heidegger 1977: 69).

The meaning of things becomes accessible through the nature of being of their handiness, in a non-reflective manner and not by the juxtaposition of subject and object, but in the direct use and usability of things and their connection as equipment. Equipment is experienced practically through using it in the usual way; it is not theoretically deduced and reflected on. In his 1919 lecture "Introduction to Metaphysics", Heidegger describes how, on entering the lecture theater, he experiences the lectern. Without expressing this experience verbally, he asks his audience what it is that "he" can see: not brown planes that intersect at right angles, and not a box, i.e. a larger box with a smaller box on top. No, he sees the lectern from which he is meant to deliver his talk. His audience, he posits, sees the lectern from which they will be addressed and from which he has already been speaking. As Heidegger continues, he specifies how he experiences the lectern:

"I see the lectern in one fell swoop, so to speak, and not in isolation, but as adjusted a bit too high for me. I see – and immediately so – a book lying upon it as annoying to me (a book, not a collection of layered pages with black marks strewn upon them), I see the lectern in an orientation, an illumination, a background." (Heidegger 1987:71).

The often-repeated lectern story exemplifies the situation of being-in-the-world and of the situation of the "Dasein" in an already defined context of meaning. Objects do not arrive in our consciousness as individual elements which are observed or analyzed in isolation from each other.

Rather, they are experienced in their entirety "in one fell swoop, so to speak". "Dasein" and things exist in the same dimension of the world.

As this event also shows, disruptions, such as a book left behind, or a lectern set to the wrong height, enable things to appear in our consciousness as individual and allow us to perceive them as separated from the context of meaning, causing a shift to occur from our habitual everyday attitude towards imagining things as objects. If the regular functioning of a piece of equipment is disrupted, for instance, if a thing is missing, if it lacks some of its characteristics, or if it is damaged, "Dasein" steps out of the frame of everyday life and of being-in-the-world, regarding the world in the mode of being Heidegger called "Vorhandenheit" (presence-at-hand). Presence-at-hand is a form of being in which the things of the world are no longer familiar to the "Dasein", i.e., they are no longer used in an ordinary fashion. Instead, the "Dasein" faces the world in a bipolar manner, which causes things to become objects. Heidegger felt that the pure presence-at-hand of equipment could be grasped before it retreated again into the handiness of that which is in a state of reconstruction (Heidegger 1977: 73).

The term "presence-at-hand", which Heidegger contraposes to the term "handiness" finds its equivalent in scientific thinking, in which things are only regarded as objects and considered theoretically. In the following part, this concept is reexamined and continued in the context of analyzing Heidegger's philosophy of technology.

The Question Concerning Technology
Criticism of Calculative Thought

As previously described, presence-at-hand is a concept which corresponds to scientific thinking, where things are considered as objects and regarded from a theoretical perspective. This purely theoretical approach, where the things of the world are not experienced directly but where they are described and experienced as an image or concept is criticized by Martin Heidegger. He reaches far into the history of philosophy, tracing the origins of theoretical thinking, and the turning of "truth" within an unconcealment (aletheia) of things into mere "rightness", back to Plato. In his text "Plato's Doctrine of Truth", Martin Heidegger critically discusses Plato's Allegory of the Cave from the 7th volume of his work Politeia (The State).

He shows how Plato no longer defines truth as mere unconcealment where things themselves are revealed as they are, but as rightness. Truth, according to Heidegger, is no longer unconcealment, the essential feature of being itself. As a result of its subjugation to the idea, it has become rightness, henceforth the distinguishing mark of being (Heidegger 2004: 143).

With that text, Heidegger defines truth as rightness, i.e. as the individual accepting ideas he or she considers as right. He believed that the

story told in the Allegory of the Cave forms what is still and will continue to be what is really happening in the history of the Western civilization. With regard to the nature of truth as the rightness of what is imagined, we consider everything that is, i.e. all "being" as "ideas", and we evaluate everything that is real as "values" (Heidegger 2004: 143).

According to Heidegger, this creates an anthropocentric attitude in philosophy which has affected the entire ontology of the Western world (Heidegger 2004: 140).

Heidegger criticizes in particular the absolute imagination according to which the individual and the things of the world are positioned to face one another; where things are experienced by us scientifically and are thus instrumentalized. The way in which the "Vorstellen", i.e. the representation or setting-out, manifests itself, is through mathematical calculation:

Heidegger explains the term "Vorstellen" as setting something out before oneself, protecting it as is. This has to be an act of calculation, for only calculation can guarantee to be certain, beforehand and continuously, of that which is being set out.

Calculative thought causes human "Dasein" to step out of the world, instrumentalizing it. Heidegger described this somewhat harshly. The setting-out, he said, was no longer the "Sichentbergen" (revealing oneself) but the seizing and grasping ("Ergreifen" and "Begreifen"). What dominated was not that which was present but the attack (Heidegger 1977: 100).

The Nature of Modern Technology

Martin Heidegger took up the analysis of calculative thought in his text "The Question Concerning Technology" of 1953, developing it considerably further. The text tries to determine the nature of modern technology. Heidegger was determined to describe the nature of technology without bias and without the use of technical terminology and concepts. He started by stating that the essence of technology was nothing technical at all (Heidegger 2000: 10). Similarly, he rejected the frequently expressed idea of technology as a medium controlled by mankind for a purpose. To his mind, technology in terms of a means to an end and as something done by humans should be called the instrumental and anthropological determination of technology (Heidegger 2000: 11). Martin Heidegger made no attempt to describe machinery or equipment; he explored the world relationship between mankind and technology in the modern, technologized world.

Modern technology according to Heidegger is a manner of "Entbergen" or uncovering something, but not within the meaning of bringing something to the surface, or of producing something, but rather an act of "Herausfordern", at the same time a challenge and an act of extraction.

In other words, nature is being challenged to supply energy which can be extracted and stored (Heidegger 2000: 18).

In the course of this challenge and extraction, nature is being engaged. Heidegger gives various examples of this: agriculture becoming motorized food industry, the air a supplier of nitrogen, and the soil a source of ore (Heidegger 2000: 19). According to Heidegger, it is not solely mankind that dominates and controls technology: Mankind is also engaged and challenged in terms of how it engages and challenges technology. Mankind and technology are located in the same dimension, for which Heidegger coined the term "Ge-stell". This is a complex construct of different concepts including "Herstellen" (manufacturing), "Bestellen" (ordering, tilling a field), "Zustellen" (delivering), and the challenging "Stellen" (engaging), which together make up the nature of modern technology. According to Heidegger, the development of modern technology by mankind has fundamentally changed its relationship to the world and to technology. In the constellation of the "Ge-stell", we are challenged to view and operate nature and reality as a whole as "Bestand", a word used by Heidegger and which contains the ideas of "inventory" and of "permanence/sustainability". "Ge-stell" refers to the collecting nature of the act of engagement which engages an individual, i.e., challenging him or her to uncover ("entbergen") as "Bestand" that which is real in the nature of "Bestellen". "Ge-stell" is also the nature of the act of uncovering, which dominates in the nature of technology - although it is not technological in itself (Heidegger 2000:24). Heidegger uses the word "Bestand" to describe a world relationship in which everything that is real is ready and is challenged to extract ("herauszufordern") nature's energy. In this way, Heidegger describes the situation of a technologized world where nature is permeated by technology just like the tools and things of everyday life. The world as well as mankind become exploitable materials, and jointly they are situated in a dimension of the "Ge-stell" in which each challenges the other. Technical devices are no longer autonomous tools manufactured and utilized by people. By being tied into the constellation of the "Ge-stell", they lose their autonomy, and their status consists solely of ordering and tilling that which can be tilled, i.e., the "Bestellen von Bestellbarem" (Heidegger 2000: 20). Even mankind itself becomes "bestellbarer Bestand", i.e., inventory that can be ordered, usable material, and thus an economic resource. Heidegger compares this to the situation of a forest manager who measures and inspects wood that has been cut and who seems to do this in the same manner as his grandfather before him, even though he is these days controlled ("bestellt") by the wood processing industry (Heidegger 2000: 22).

On the other hand, Heidegger assigns mankind a special role with the modern technologized world because, as opposed to non-human reality,

people operate technology and therefore take an active part in the act of ordering and tilling as a kind of uncovering, i.e., "Bestellen als einer Weise des Entbergens" (Heidegger 2000: 22). Yet mankind has always been a part of the technical world; it is immersed in it, in fact. Individuals cannot decide the nature of their relationship with technology. They can however assume different attitudes towards the nature of technology within the meaning of the "Ge-stell", and they can themselves engage in technology in different ways and make decisions as to when and how they are challenged by it (Heidegger 2000: 28).

Martin Heidegger himself neither has an affirmative nor a negative attitude towards modern technology. Instead, his text "The Question Concerning Technology" penetrates to the nature of modern technology and analyzes in an objective manner the embeddedness of humans and things in a modern, technical world.

Analysis of Ubiquitous Computing According to Martin Heidegger's Notions of World and Technology
Dealing with "Smart Things"

In discussing ubiquitous computing, the literature often talks about "smart things" or "smart objects". Smart things are the everyday objects which are modified by means of the basic technologies of ubiquitous computing described in the first part of this paper and which thus become part of the Internet of things. Everyday examples include tools (e.g., a power drill) with sensors that detect incorrect usage and alert the user, or connected homes where, for instance, food consumption is monitored electronically (e.g., through an "intelligent fridge"), and where a grocery order is automatically sent out as soon as supplies fall below a certain threshold (Christ, Fleisch 2003a). Due to automation and communication with other smart things, smart things can themselves run through processes, reducing people's workload or helping them in operating things (e.g., a power drill), therefore providing them with easier access to them.

With regard to the first case (automation of routine tasks), people are not themselves the actual users (within the meaning of handiness) of the smart things, and the things act autonomously according to previously defined rules. Technical devices and functions are no longer perceived as they are. In an everyday context, a person (the "Dasein") only notices the results of the automated processes; the smart things are not perceived as tools or devices. The nature of things as tools disappears within the meaning of the vision of ubiquitous computing formulated by Mark Weiser, and, taking this to the extreme, technology disappears altogether from an individual's environment.

With regard to the second case (support in dealing with things), well-designed functions can give us easier access to things and help us deal with things more easily; at the same time, things can be utilized as "smart equipment" in a non-reflective manner, i.e. they are in the mode of being Heidegger called handiness. Ideally, smart things integrate seamlessly into everyday life and everyday processes and can adapt either in accordance with users' behavior or by reacting to environmental changes.

As a result of the exponential rise of computer technology in everyday life, the probability of smart things not working, or not working well enough (due to, for instance, weak communication links, empty batteries, or system crashes), is also growing exponentially. Every malfunction detaches the smart thing in question from the everyday environment and the handiness mode. In line with the analysis of the different modes, handiness and presence-at-hand, as described above, this causes the "Dasein" to no longer be in-the-world. Instead, it is separated from the world and observes it from the outside. The world relationship scientificizes itself. Smart things and an everyday world permeated by IT prevent, on the one hand, direct access to the things and to the world (in the automation mode) or, on the other hand, they promote the loss of the word we are used to (as a consequence of badly designed smart things, technical defects, and malfunctions). Everyday things are thus faced by the "Dasein" in the presence-at-hand mode of being. Furthermore, integrated smart things frequently go hand in hand with the disappearance of interfaces, i.e., the loss of opportunities for mankind to take action and control the ubiquitous computer system. The system and the smart things cannot be manipulated, and individuals are thus excluded from operating them directly (Heesen et al. 2008: 1).

In both cases, the ubiquitous computing world is no longer experienced as an everyday world in which the "Dasein" already finds itself, either because part of the technologized world is not visible to the human eye, opportunities to control system processes are decreasing, and the "Dasein" is no longer embedded the world, or because, more frequently than in a non-IT world, the "Dasein" is affected by out-of-order or malfunctioning things and steps out of the everyday mode of being-in-the-world, facing the things and the world from the outside looking in. The phenomena and scenarios described here are dependent on several factors: the actual design of the smart things, the quality and availability of the ubiquitous computing infrastructure, and technological developments.

Increase in Meaningfulness?

Smart things have the potential to increase in meaningfulness within the meaning of the situation of being-in the-world. By adding information

and new functions, things are modified and can be integrated with each other. Provided there is a well-designed system and well-designed smart things, this can increase the frame of reference of the everyday world as a whole for the "Dasein". This is exactly what smart things seem to suggest to users. They suggest communication, adaptation to the environment, contextual knowledge, etc. Always, however, the meaning of smart things and of their communication structure and contextual knowledge is based on previously programmed structures, which determine a previously programmed scope of experience (Heesen et al. 2008: 10).

The disappearance of the computer within the meaning of ubiquitous computing also causes the disappearance of possibilities to intervene in the system, and the previously programmed structures and algorithms are not recognizable in everyday life and not changeable. It is therefore questionable whether the meaning of things is increasing for the "Dasein" and if in a world of ubiquitous computing mankind still finds itself within the frame of reference, with the everyday things ready-at-hand and their use habitual, or whether people may be part of a system they have not themselves programmed while never gaining immediate access to the Internet of things. An approximation of mankind and smart things is only a possibility if people create their world of everyday smart things themselves and are able to change it, or if the smart things are programmed in such a way as to be adaptive and able, without fixed structures and "world models", to develop these themselves in the course of their everyday use.

"Dasein" in a Digitalized World

The development of modern technology, in particular information and communication technology has caused the relationship between mankind and reality to fundamentally change. The world has been shaped and redesigned by technology, and the individual is completely tied into the technologized world. The concept of "Ge-stell" introduced by Martin Heidegger to the philosophy of technology describes the situation of mankind and technology in a world shaped by modern technology. Both, mankind and technology, are tied to one dimension and share the same world. They engage and challenge each other. The key technology of the last few decades is the information and communication technology within which ubiquitous computing constitutes the technologically most advanced phase (Heesen et al. 2008: 1).

Ubiquitous computing designates a vision of an informationalized world, in which everyday objects are modified through computer technology such as RFID, sensors and sensor systems, tracking systems, or small computer units, giving them additional information or functions and integrating them with their environment. The basis for all ubiquitous

computing concepts and installations is the expression of real-world things and processes as mathematical quantities and concepts, and the connecting of individual values and concepts with each other. The basis for all information technology is the reduction of reality to figures and calculable structures. Mathematics is the foundation of computer science, and thus the foundation of ubiquitous computing.

In an informationalized everyday world, all things and processes are described by, and reduced to, measurable and calculable quantities and relationships. The nature of ubiquitous computing is calculation. Calculative thought is the essence of the digitalized world.

Both the things of reality and everyday phenomena are reduced to data and mathematical quantities (and processes to algorithms), and due to the integration of computers this procedure can no longer be experienced and is no longer perceived by us. The way to a direct, original experience of truth and world is obstructed by the informatization of the everyday world. The individual is always already situated in a world reduced to data and mathematical functions, a situation described by Martin Heidegger even before the arrival of information technology:

The threat to man does not come in the first instance from the potentially lethal machines and apparatus of technology. The actual threat has already affected man in his essence. The dominance of the "Ge-stell" threatens man with the possibility that it could be denied to him to enter into a more original revealing and hence to experience the call of a more primal truth (Heidegger 2000: 32).

The instrumentalized relationship to the world is however not the only possibility for the individual in a technologized world. In a memorial address entitled "Gelassenheit" (equanimity) (Heidegger 2012) published in 1955, Martin Heidegger describes different attitudes of people towards modern technology, emphasizing the fact that in a technologized world mankind cannot achieve a non-instrumental relationship to the world without rejecting, or evading, technology itself. To further explore this subject area, which is not within the scope of the current article, the study of the above-mentioned memorial address is recommended.

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