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THE ROLE OF ADDITIONAL INFORMATION IN THE CONTROL SYSTEM

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ABSTRACT

As a result of rapidly evolving technology, the energy hunger of the world is also increasing. Depletion of fossil resources is also a problem in addition to growing energy hunger. Climate change also presents us with ongoing challenges that also affect energy supplies. These problems and challenges must be answered and solutions must be found. Mankind needs to switch to the use of climate-neutral resources and to the operation of energy-efficient models. Increasing efficiency also requires the development of an effective control system. The basic element of system control is the cybernetic loop. The present study examines the efficiency of the first phase of the cybernetic loop, the efficiency of sampling.

KEYWORDS

additional information, control system, cybernetic loop, energy model, energy importance

CLASSIFICATIONS

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INTRODUCTION

The base of the smart city concept is to preserve long-term sustainability. The use of complex systems goes hand in hand with the development of the industry. Unfortunately, the energy efficiency of complex systems is not yet ideal. In this way, the development of the industry entails an increase in energy demand [1, 2].

Satisfying humanity's energy hunger is facing serious problems these days. The excessive use of fossil resources has also contributed to global climate change. In addition, the process has reached the limit of fossil resources depletion. For these reasons, past energy use patterns cannot be maintained either. This affects both industrial production and households[3-5].

Solutions to the problem may include switching to climate-neutral resources, more flexible energy use methods and more efficient energy use. Energy efficiency also requires efficient system control. Theoretical study and modeling of system control has also become an increasingly important area of education [6-10].

The present study examines the efficiency of system control. The basis of the study is the energetic background of the control theory cybernetic loop model. The efficiency of the sub-processes of the cybernetic loop determines the efficiency of the entire cybernetic loop. The first sub-process of the cybernetic loop is the sampling method from the operation of the system. The study models the impact of sampling efficiency across the entire cybernetic loop.

CONTROL SYSTEM

Each system serves a purpose. There are several factors that can affect operation. Controlled operation of the system includes checking the correct operation of the system and any adjustments to the operation. Thus, the control also ensures the sustainability of the system. A continuous version of this management is the control system. System regulation is essential to the operation of the system. The expected operation of the system cannot be ensured without regulation [11-14].

In control theory the cybernetic loop is a fundamental element of the system control model. The cybernetic loop model includes a time-negative feedback process that can be broken down into three major subphases. Interactive sampling takes place in the first phase. A snapshot of operating parameters of the system is taken. The analysis of the parameters, the comparison with the required state, and the intervention decision are the elements of the second phase. Then the interactive intervention takes place in the third phase [15-18]. The model of the cybernetic loop is shown in Figure 1.

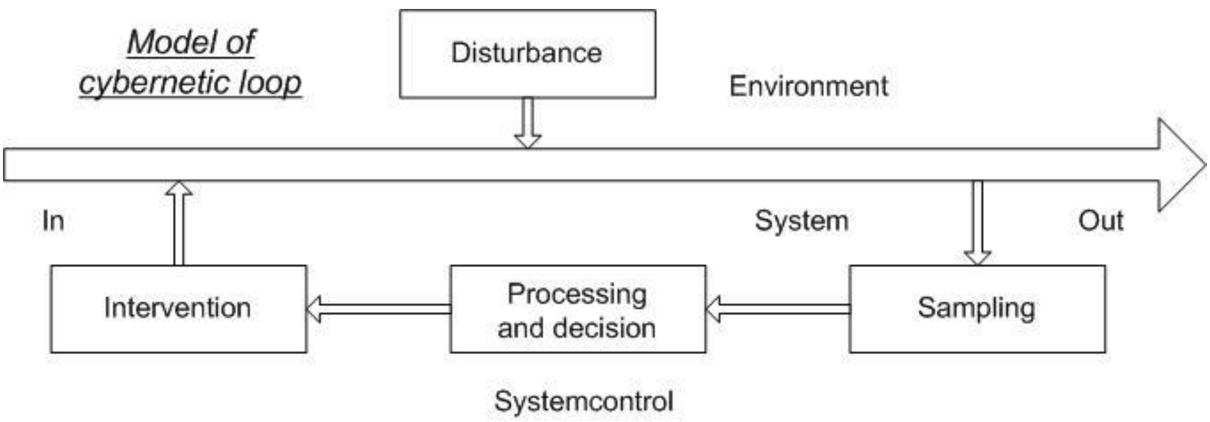

Figure 1. Model of cybernetic loop [13].

ADDITIONAL INFORMATION

The purpose of communication is to transfer information from one entity to another. In the course of communication, the sender usually sends not only the necessary information, but also additional data content in addition to the useful information. This can be caused by intentional redundancy and unintentionally sent data. However, unintentional extra data may carry significant additional information that may provide additional information to the communications receiver [19].

A multi-round online game has been created to model the additional information: Guess where the doll is! In a given round, photos were taken as if a toy doll had taken selfies in a particular location. It was up to the players to guess the location using the additional information in the background. The surprising result of the game was that the players could not only decode the information that the organizer was thinking. Players were also able to decode additional information about the doll's manufacturer and clothing [19]. A mix of images from the game is shown in Figure 2.

Figure 2. Mix of pictures from the game, based on [19].

EFFICIENCY OF SYSTEMCONTROL

Additional information is a natural part of communication. In the cybernetic loop model, one form of communication is sampling. Thus, the model of the cybernetic loop should also be examined in order to model the effect of the additional information.

The initial assumption is that additional information is coupled with useful information during sampling. In this case, sampling contains more than just useful data. The test of the usefulness of the data and the sorting of the useful data take place during the non-interactive data processing.

For all these reasons, in the case of additional information appearing during sampling, the useless data must also be transmitted to the place of processing. The useless data must stored at the place of processing. This useless data should then be processed to determine the need. Consequently the appearance of additional information in the sampling procedure results unnecessary energy consumption. Information technological implications of this are:

- energy of transmitting unnecessary data,
- energy of processing unnecessary data,
- energy of storing unnecessary data.

Figure 3 shows a version of the cybernetic loop model supplemented by sampling with additional information.

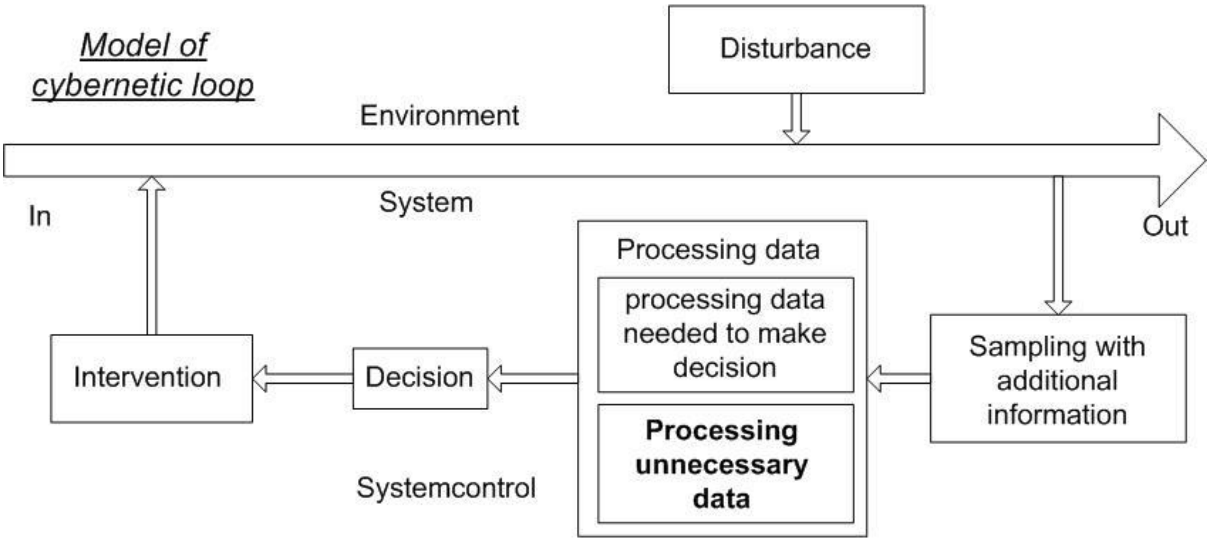

Figure 3. Cybernetic loop – sampling with additional information, based on [13].

SUMMARY

The need for long-term sustainability has brought with it the industry 4.0 concept and the smart city concept, among others. The motto of the models is sustainability. One of the pillars of ensuring sustainability is energy efficiency. Energy efficiency also depends on the efficiency of the control system.

The cybernetic loop is a basic element in the modeling of the control system. The sub-processes of the model are sampling, the processing process with the decision, and the intervention. The efficiency of these sub-processes strongly influences the efficiency of the entire control system. The data content of the sampling sub-process determines the energy requirements of the processing process.

The present study is based on the cybernetic loop model. The study complements this model with additional information that appears during sampling. Modeling the role of additional information in the cybernetic loop has shown that the presence of additional information generates unnecessary energy consumption. This occurs in storage, processing and transmission of energy, too. Thus, the additional information present in the regulatory system can significantly reduce the efficiency of the system.

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