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DEVELOPMENT OF MICROCONTROLLER SYSTEM FOR OBTAINING AND PROCESSING PRIMARY INFORMATION WITH HEURISTIC ALGORITHMS SELF-RESTORING

Nowadays computers networks are used transferring lots of data. However, sometimes a network cannot work properly which creates problems during data transferring. Problem should be managed by developed an algorithms which provides self-recovering. Moreover, the exact algorithms might need centuries to manage with formidable challenges. In such cases, heuristic1 algorithms that found approximate solutions, but still indispensable role have acceptable time and space complexity. This paper presents heuristic algorithms for microcontrollers system and Ethernet network or other type of data transferring networks for receiving measuring from sensors. The article addresses the issue of minimum delay of self-recovering in the context of fully connected networks and structured topologies used by many peer-2-peer systems.

Keywords: *heuristic; Ethernet; algorithms; self-restoring; data processing; microcontrollers.*

I. Introduction

Elements of microcontroller systems receive information from sensors in the form of electrical parameters of voltage, current and frequency of electrical oscillations. These elements have no intermediaries and are the first link in the chain of successive stages of information processing. Features of microcontroller are small amount of memory limitations in CPU speed, which require increased stability in software development and its validation [1].

Practice of modern software development is wide use of ready libraries and procedures for the implementation of complex elements of communication protocols between the individual components of the system. These libraries from the perspective of a software developer look like a «black box» with certain conditions at the inlet and outlet. Subject to the hardware and software environment, developer libraries and user of the library can expect adequate results. However, full compliance with hardware and software is only possible with full duplication of equipment and processing algorithms [2].

If task is developing of new product, the conditions of identity hardware and algorithmic environment violated. This leads to the «unexpected» failure of individual elements of the complex or the entire complex. To deal with such refuses can be by analyzing of algorithm in texts of libraries, and eliminate errors. However, this method requires a deep dive into problems and spends large time to solve. In practice, limited to such conditions, when errors occur, but not very often. Under such conditions, the reliability of the system acquires probabilistic nature [3].

If know about a possible rejection of the system, it is necessary to provide methods for fastest recovery with minimally acceptable loss of information.

II. Methods

The subject in this article is heuristic algorithms of self-recovering. Main tasks to solve the following problem:

– propose a working model of information system for energy efficiency measures;

– testing of hardware and software self- recovering;

– the creation of heuristic algorithms performance evaluation system;

– choose the best option to use wired and wireless connections between elements of the system;

– developing ways of improving the reliability of the system.

The implementation of this system is associated with direct support permanent disability. This criterion is important in any industrial product. However, no products are that would allow building a completely reliable network at present. There are only certain technical and software solutions for increased stability systems and specialized units for each problem using certain solutions [4].

The implementation of these procedures in an automated system after a few minutes of normal operation resulted in a sudden stop. As it turned out later, the reason was an error initializing the variable program, which led to a stack overflow after a few dozen calls to the sensors.

Elements of the system failure of one server microcontroller are approximately no more than once every two weeks. The corresponding probability of failure daily $\overline{P_1(day)} \approx 1/14$. Given the typical frequency of queries, such as query 1 to 5 minutes, obtain the probability of failure on request

$$\overline{P_1(\text{request})} \approx \frac{1}{14 \cdot 24 \cdot 12} = 1/4032 \approx 0.25 \cdot 10^{-4} \quad (1)$$

Identifying the reasons for refusal at such a low probability is extremely challenging and requires significant time. However, low probability of failure of one server becomes a high probability of failure of at least one server with a large number of servers. For N server probability of system failure is defined by the equation

$$\overline{P_N(day)} = (1 - P_N(day)) \quad (2)$$

where $P_N(day) = P_1(day)^N$ – the probability of the N elements. This probability is related to the probability of failure of one element $P_1(day) = 1 - \overline{P_1(day)}$.

Thus the probability of system failure with N elements is defined by the equation

$$\overline{P_N(day)} = 1 - \left(1 - \overline{P_1(day)}\right)^N \quad (3)$$

Substituting the specific values of the probability of failure for the experimental system that consists of 10 servers, get

$$\overline{P_{10}(day)} = 1 - \left(1 - \overline{P_1(day)}\right)^{10} = 1 - (1 - 1/14)^{10} \approx 1 - 0.47 = 0.53 \quad (4)$$

That is, when the probability of such a failure in at least one element of the system should occur about once a day - once in two days.

This situation, unfortunately, was observed in the experimental system. Failure of one microcontroller occurred very rarely, so that you can identify the cause of failure, but too often for the system as a whole.

III. Results

Using heuristic algorithms allows accumulating base errors found in program code, which simplifies the job programmer. Also possible to temporarily resolve the error by using different procedures designed to prevent the occurrence of situations is not regular.

When using a heuristic algorithm is likely to protest the least likely problems A and B, with a negative result will be considered an error log to the fact that often occurred in or D to decide on a method of eliminating errors. If you are saving periodic crashes it will be considered a bug that is not entered in any of the lists, and therefore will be added to the list.

The use of this type of algorithms would reduce the risk of errors, and increases the reliability and information for software developers pointing out errors that have occurred during explanation system.

As mentioned, for this class of problems is a well suited heuristic method. Heuristic algorithm is able to give an acceptable solution among many solutions. Typically, these algorithms are close to the best solution and do it quickly. This algorithm can be accurate, ie, to find the best solution, but it will still be called heuristic, until unless it is proved that the solution is really the best.

Figure 1 shows work status of web-server during day with out algorithms of self-recovering. As a result, reliable testing of microcontroller server for data collection was discovered flaw. If the server no request for long time can overflow buffer, resulting in the disappearance adapter from network.

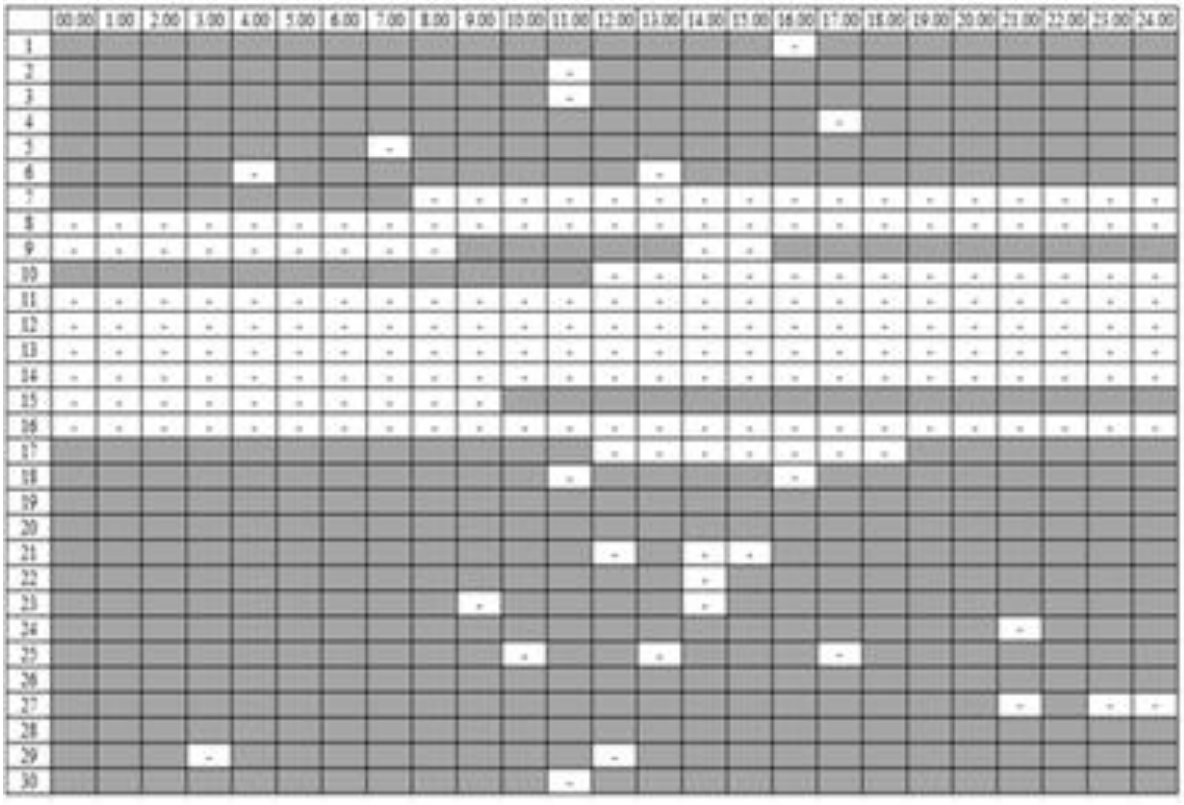

Fig. 1. Sensor Performance and Reliability (before)

Number of errors was decreased which show figure 2, after applying heuristic algorithms of self-recovering. Using the algorithm allowed to develop foolproof system that handles well and corrects errors that have occurred in the course of transmission network which provide measurement data. Implementation of the system in industrial facilities will reduce the cost of hardware [5].

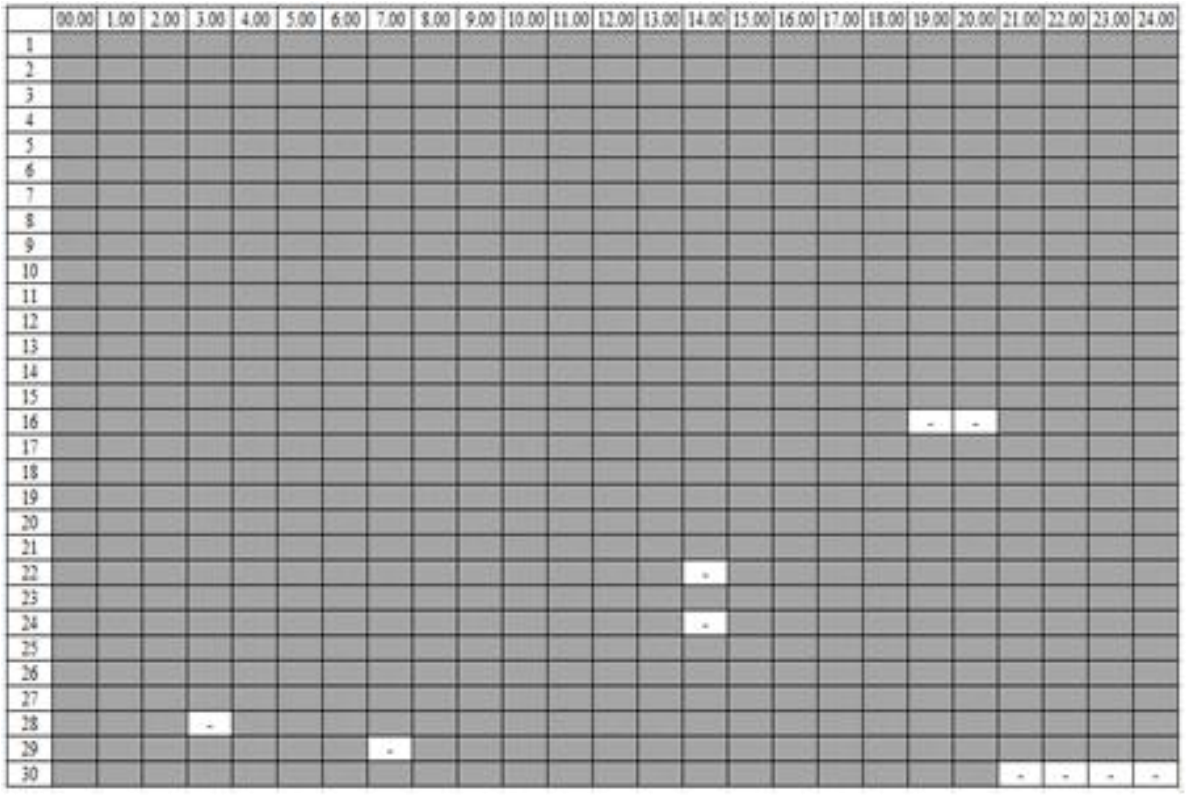

Fig. 2. Sensor Performance and Reliability (after)

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РОЗВИТОК СИСТЕМИ МІКРОКОНТРОЛЕРА ДЛЯ ОТРИМАННЯ ТА ОБРОБКИ ПЕРВИННОЇ ІНФОРМАЦІЇ З ЕВРИСТИЧНИХ АЛГОРИТМІВ САМОВІДНОВЛЕННЯ

Розглянуто проблеми побудови системи збору й обробки інформації на базі програмного забезпечення з негарантованою надійністю.

Ключові слова: *програмне забезпечення; негарантована надійність.*

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РАЗВИТИЕ СИСТЕМЫ МИКРОКОНТРОЛЛЕРА ДЛЯ ПОЛУЧЕНИЯ И ОБРАБОТКИ ПЕРВИЧНОЙ ИНФОРМАЦИИ ПО ЭВРИСТИЧЕСКИМ АЛГОРИТМАМ САМОВОССТАНОВЛЕНИЯ

Рассматриваются проблемы построения систем сбора и обработки информации на базе программного обеспечения с негарантированной надежностью.

Ключевые слова: *программное обеспечение; негарантированная надёжность.*

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