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ANALYSIS OF THE STRUCTURE AND CALCULATION OF TIME FOR THE ENVIRONMENTAL MONITORING SYSTEM WITH MULTI-PARAMETER SENSORS

Abstract. In the last decade, engineers, researchers and developers are paying more attention to development and development multi-function sensor is a new trend in modern sensor technology.

This paper discusses the structure of the information systems (IS) and mobile application (app) for the Control and Monitoring of the Environment [1-3, 7, 9-21], the main parameters, based on which developed the structure of IS and mobile application [1] developed a mobile app for the calculation of the time spent on the sending and receiving of information (one cycle) with all the delays in the system.

To date, known to a sufficient number, as well as scientific and practically realized works that perform the functions of control and monitoring of the environment [4, 11, 13-19, 25, 27, 28].

Ensuring control and monitoring objects today is a strategically important aspect to save the current condition, or prevent not desirable consequences in the environment, thanks to timely make the right decisions.

Keywords: environment, monitoring, control, multifunctional sensors.

Introduction. With the improvement of technology, software products, digital devices and sensors often found solutions that are more costly to service, on energy demand as well as on the reliability of information storage.

Development of multi-parameter sensor is one of the important goals of modern engineering, research and development. With the development of technology and the development of methods of multifunctional (multiparameter) sensors today expanded the following applications: robotics, automation, medicine, vehicles, etc. [5-11].

Multifunction sensors and systems for environmental monitoring and process parameters is suitable for indoor and outdoor use, and for all sectors of residential, industrial and tertiary. Depending on the sensor model, it is possible to measure one or more parameters, such as temperature, contact temperature, relative humidity, light, atmospheric pressure and counting pulses from the electrical energy, gas, water, etc. [1-20].

Remote access to devices and sensors using the mobile app provides a great opportunity to monitor performance of the entire system, which simplifies the process of monitoring of all system components. Data can be exported into various formats and programs to perform more complex statistical analysis.

Information System for Environmental Monitoring collects data from sensors for various purposes. Data processing time on each element of the structure, which are presented in Figures [1, 3] has a significant impact on the quality of the functioning of the entire system depends on the reliability of every element of the system, the overall processing the time and accuracy of information.

1. Environmental monitoring systems structures. As a result of analysis on modern environmental monitoring system (the system), and their structures were determined basic parameters, technical and

industrial areas, where it is often used multi-parameter sensors. Data collection and processing of information, depending on the elements of the system is carried out at different time intervals. Features of each system [13-19] are a little different, but perfectly perform the basic functions of collection, processing and storage of recorded data from the sensors.

Comparative analysis [13-19] made it possible to understand in more detail how the system is complex, what features are offered, what is the minimum number of elements should include, on the basis of data obtained by statistical analysis and environmental monitoring for specified parameters.

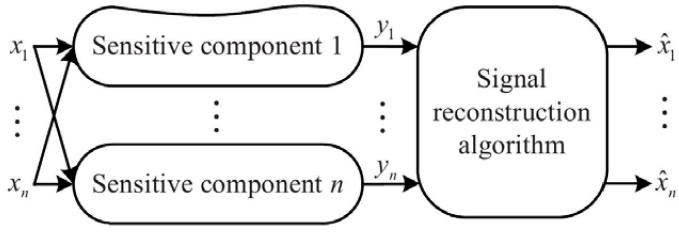


Figure 1 – Schematic structure of a multifunctional sensor [10]

Consider some of [10-21], which shows the scheme and structure of multifunctional sensors (Figure 1), Structure of water environmental monitoring structure of environmental monitoring systems in Figure 2 [13]:

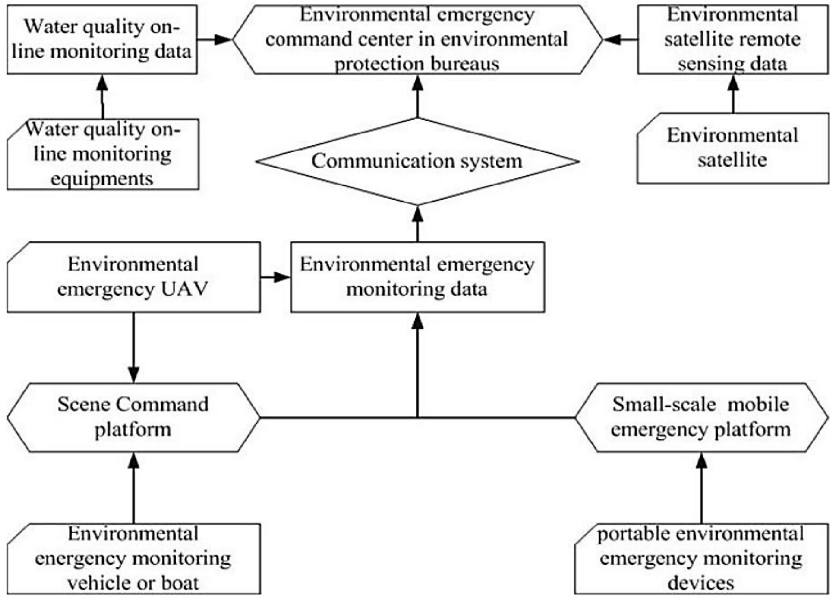
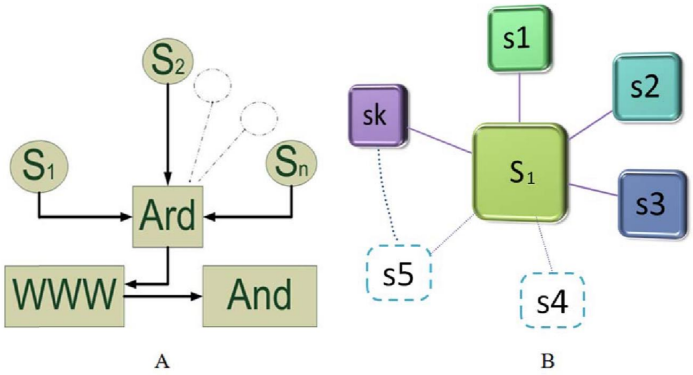


Figure 2 – Structure of water environmental monitoring network based on space-earth integration system [13]

The structure of the information system (IS) [1] is essential to ensure the effective management of information resources. The structure of IS helps to identify some elements that complicate the passage of information flows and increase the risk of information loss, which has a negative impact on the quality of the functioning of IS.

Application of multifunctional sensors [2, 5-12, 21-23] are known to simplify the structure of control and environmental monitoring system, where the main purpose - providing a scalable, efficient and compact solution that integrates multi-parameter sensors (several sensors in one).



WWW – World Wide Web; Ard – Arduino uno; And – Android app;
S_1, S_2, S_3 … S_n – multifunctional sensors; s1, s2, s3, s4, … sk – sensors.

Figure 3 – Structure of IS (A) [1] and functional structure of multifunctional sensor (B)

In [1] considers the analysis of problems and methods of implementation of information systems for monitoring natural and industrial facilities. The new approach of data storage, integration and retrieval developed. The practical applicability confirmed through experience in the development of information systems for the processing and analysis of spatial data using a mobile application. The structure of the software and information system allows both users and developers to understand the operation of IS, determine the number of its elements and learn what kind of details it consists.

Reducing the number of sensors and increase functional capabilities gives an advantage over the developed and the existing environmental monitoring systems, by reducing the physical parameters (volume, mass).

2. Software development of the android APP. There are several platforms for developing applications such as Windows Mobile, Symbian, iOS and Android. In the proposed system, the Android platform app is developed as most of the phones and handy devices support Android OS. Java programming

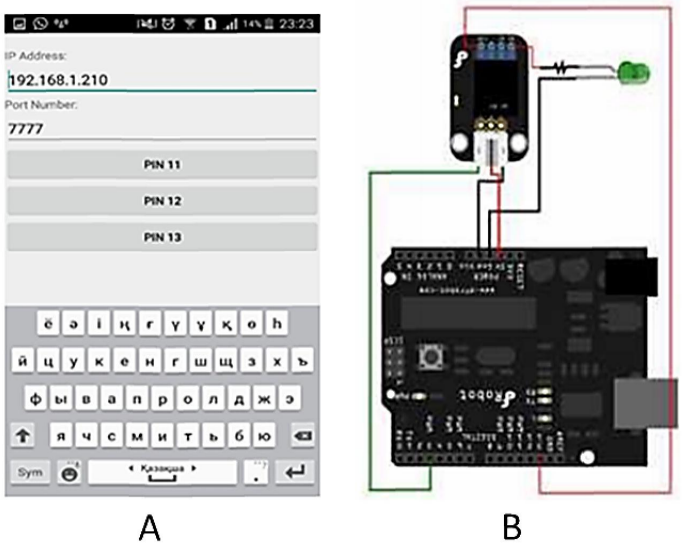


Figure 4 – Mobile application (A) and Example of Relay Configuration (B)

language using the Android Software Development Kit (SDK) has been used for the development and implementation of the app. The SDK includes a complete set of development tools such as debugger, libraries, a handset emulator with documentation, sample code and tutorials.

Mobile application is designed for checking sensors and recording time send and receive commands/data from the mobile device to the sensor and back Figure 4 (A).

Basically several types of the device can be used as a relay switch of electronic equipment, for example electric lights, electric motors, and a variety of other electronic devices. In this system, the relay is used to power-down automatically based on the order which is specified by the value of the output, which has been processed by microcontroller or controller device. The device is used to adjust the flame relay and the turning off of electronic devices. Relay is connected to the pin on the Arduino Mega Figure 4. (B) [19] and connected also with the electronic device. This device includes Kit Relay device for electrical appliances AC/DC and pin cables and connectors.

3. Device testing. Testing is carried out into three parts, namely turn on/off testing, dim testing and current electric record testing. Testing carried out Android smartphones (LG P500 ICS 4:04) and virtual iPhone. First, before the testing is conducted, it is executed to see how long the smartphone takes log time level to arrive in the Main Menu. The time is measured based on how long this application takes time to login and reverse current that is in the main menu. This test is needed to ensure the user waiting time is not too long, the result of this test is shown in Table 2. Table 1 show that the system needs maximum 5 seconds to achieve the main menu. Virtual iPhone and Virtual Android using wireless is the lowest time in achieving the main menu, while the highest is the virtual android using EDGE network. So based on the experiments done on two smartphone devices found that the likelihood of a successful login at least 100% on EDGE networks. With a maximum waiting time of four seconds. It can be concluded that the application is already running pretty fast.

Table 1 – Login Time Test

Device	Network	Time Request	Results
Virtual iPhone	Wireless	3s	Success
Virtual Android	Wireless	3s	Success
	3G	4s	Success
	EDGE	5s	Success

The next testing for this system is "Turn on/off" and dim testing. These testing are carried out using Android smartphones (LG P500 ICS 4:04) and virtual iPhone. The test is done to see how this app can turn on, turn off and dim the electronic device. The result of the "Turn on/off" and dim testing is shown in Table 2 and Table 3 respectively.

Table 2 – The Result of "Turn off/on" Testing

Device	Arduino Pin	Electronic Device	Dim
Virtual iPhone	Pin 5	Lamp	ok
	Pin 4	Lamp	ok
	Pin 3	Lamp	ok
Virtual Android	Pin 5	Lamp	ok
	Pin 4	Lamp	ok
	Pin 3	Lamp	ok

Table 3 – The Result of Dim Testing

Device	Arduino Pin	Electronic Device	ON	OFF
Virtual iPhone	Pin 5	Lamp	ok	ok
	Pin 4	Lamp	ok	ok
	Pin 3	Lamp	ok	ok
Virtual Android	Pin 5	Lamp	ok	ok
	Pin 4	Lamp	ok	ok
	Pin 3	Lamp	ok	ok

Table 2 and 3 show that the system is able to control turns on/off and dims the lamp correctly. So based on the experiments which is performed on two smartphone devices, it was found that the percentage probability of success in shutting down and turning on an electronic device is 100%. Table 4 shows time that how many time was take for transformation between android and Arduino.

Table 4-6 shows the results of testing the sensors, where T1 - the time of the Android smartphone to the Arduino Uno, T2 - the time from the Arduino Uno to a sensor, T3 - full time (one cycle).

Table 4 – The Result Testing (DHT11)

DHT11 - Temperature and humidity			
№	T1	T2	T3
1	1150,5	271	1421,5
2	1194,5	272	1466,5
3	1147	271	1418
4	1199	271	1470
5	1158	273	1431
6	1159	273	1432
7	1101	271	1372
8	1161	272	1433
9	1182	271	1453
10	1175	273	1448
11	1209	272	1481
12	1125	272	1397
13	1089	271	1360
14	1175	271	1446
15	1019	273	1292
AVG	1149,6	271,8	1421,4

Table 5 – The Result Testing (DHT22)

DHT22 - Temperature and humidity			
№	T1	T2	T3
1	1283	271	1554
2	1174	271	1445
3	1211	271	1482
4	1052	272	1324
5	1185	271	1456
6	1010	273	1283
7	1095	272	1367
8	91913	272	92185
9	1216	271	1487
10	1101	271	1372
11	91975	271	92246
12	1081	271	1352
13	1167	271	1438
14	1129	272	1401
15	92454	273	92727
AVG	19336,4	271,5333	19607,93

Table 6 – The Result Testing (BMP085)

BMP085– Barometric Pressure/Temperature			
№	T1	T2	T3
1	1752	67	1819
2	1285	67	1352
3	1212	67	1279
4	1249	66	1315
5	2677	68	2745
6	1215	66	1281
7	1216	67	1283
8	57816	68	57884
9	1155	67	1222
10	1205	68	1273
11	1680	69	1749
12	1207	67	1274
13	6660	68	6728
14	1262	68	1330
15	1247	68	1315
AVG	5522,533	67,4	5589,933

Figure 5 is a graph based on the result of testing time T2 of two sensors, where T2 – time Arduino Uno to sensor.

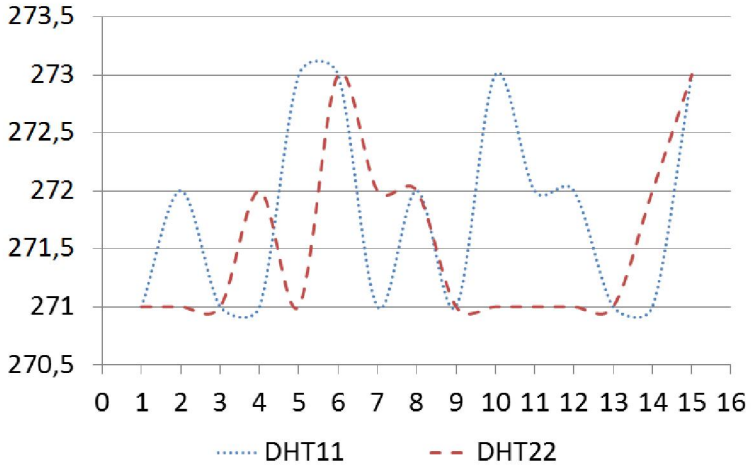


Figure 4 – Result of comparison time T2 of the sensors

Conclusion. The analysis of IS structures and mobile applications for the control and monitoring of environment, the basic parameters on which developed the structure of IS and mobile application for environmental monitoring, as developed a mobile app for the calculation of time spent on sending and receiving of information (one cycle). The focus is on the use of multi-parameter sensors and mobile application, through which defined the experimental results in this paper.

The results can be be useful for engineers, developers and users of monitoring system with multi-parameter sensors as well as for device developers.

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КӨПАТҚАРЫМДЫҚ ДАТЧИКТЕРІМЕН ҚОРШАҒАН ОРТАНЫ МОНИТОРИНГТЕУГЕ АРНАЛҒАН ЖҮЙЕНІҢ ҚҰРЫЛЫМЫН ТАЛДАУ ЖӘНЕ УАҚЫТЫН АНЫҚТАУ

Аннотация. Соңғы онжылдықтарда инженерлер, зерттеушілер мен өндеушілер заманауи сенсорлы технологияда жаңа бағыт болып табылатын көпатқарымдық датчиктердің дамуы мен зерттеліміне үлкен назар аударып жатыр.

Осы жұмыста ақпараттық жүйелер (АЖ) және қоршаған ортаны бақылау мен мониторингтеу бойынша мобильдік қосымшалардың (МҚ) құрылымдары [1-3, 7, 9-21] қарастырылды, негіздерінде АЖ және МҚ [1] құрылымы жасалған негізгі параметрлер анықталды, жүйедегі барлық кідірулерді есепке ала отырып, ақпаратты жіберу және қабылдауға (бір цикл) жұмсалған уақытты есептеу үшін мобильдік қосымша жасалған.

Бүгінгі күні қоршаған ортаны бақылау мен мониторинг қызметтерін орындайтын ғылыми жағынан да, практикалық жағынан да жүзеге асырылған жұмыстардың біразы белгілі [4, 11, 13-19, 25, 27, 28].

Нысандардағы бақылау мен моноторингті қамтамасыз ету бүгінгі күнде дұрыс шешімдерді уақытылы қабылдаудың арқасында ағымдағы жағдай сақтау мен қоршаған ортаға тигізетін қажетсіз салдарын болдырмас үшін стратегиялық маңызды аспект болып табылады.

Түйін сөздер: қоршаған орта, мониторинг, бақылау, көппараметрлі датчиктер.

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АНАЛИЗ СТРУКТУРЫ И ПОДСЧЕТ ВРЕМЕНИ СИСТЕМЫ ПО МОНИТОРИНГУ ОКРУЖАЮЩЕЙ СРЕДЫ С МНОГОПАРАМЕТРОВЫМИ ДАТЧИКАМИ

Аннотация. В последнее десятилетие инженеры, исследователи и разработчики уделяют большее внимание к развитию и разработке многофункциональных датчиков представляющее собой новое направление в современной сенсорной технологии.

В данной работе рассмотрены структуры информационных систем (ИС) и мобильных приложений (МП) по контролю и мониторингу окружающей среды [1-3, 7, 9-21], определены основные параметры, на основе которых разработана структура ИС и МП [1], разработано мобильное приложение, для вычисления времени затраченное на отправку и прием информации (один цикл) с учетом всех задержек в системе.

На сегодняшний день известны достаточное количество, как и научных, так и практически реализованных работ, которые выполняют функции контроля и мониторинга окружающей среды [4, 11, 13-19, 25, 27, 28].

Обеспечение контроля и мониторинга в объектах на сегодняшний день является стратегически важным аспектом для сохранения текущего состояния или предотвращения не желательных последствии в окружающей среде, благодаря своевременному принятию правильных решений.

Ключевые слова: окружающая среда, мониторинг, контроль, многопараметровые датчики.

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