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CREATING A “SMART” COMPUTER SCIENCE CLASSROOM AT UNIVERSITY

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Abstract. *This work aims to highlight issues related to the creation of "smart" microelectronics-based computer science classes in higher education institutions. The "smart" computer science classroom created is a fully automated educational environment that operates in its three modes: "standard", "automatic", "automatic power saving". "Samrt" cabinet can be controlled by smartphones, PCs and remote controls. Cabinet is equipped with various sensors, indicators and electronic parts based on ArduinoUNO, MEGA and ESP8266-12E WiFi modules. Measurements of built-in "smart" office sensors and indicators are used to display information on the status of the office and classroom microclimate for demonstration presentations and laboratory work. Designed for Iformatics, the Smart Cabinet consists of three modules: "Informational", "Executive" and "Demonstration", controlled by an ATMEL microcontroller. The demonstration module is designed to quickly and easily connect various sensors and components for solderless boards. Arduino open programming platform. Smart sensors in computer science classrooms can monitor the environment inside and outside the classroom (temperature, humidity, pressure, light levels, levels of carbon dioxide and other gases in the air); and remotely control peripherals: TVs, projectors, lamps, electrical outlets, curtains. All three modules are connected to a wireless local area network. "Star" topology with radio communication based on each module. The main components of the system are executive modules that have Internet access, equipment, technology and software tools. An overview of the educational system in technical educational institutions addresses the following issue: creating "smart" computer science classrooms in higher education institutions.*

Keywords: computer science; "smart" classroom; "smart" cabinet; microelectronics; Arduino; robotics; programming

Introduction

To study computer science in accordance with today's needs, it is necessary to improve the educational process, increase the cognitive activity of students, create an information culture and introduce significant improvements in the training of specialists. The learning process can be improved by using information and communication technologies and smart technologies in the educational process in higher education institutions. The goal is to improve the cognitive activity of students, create an information culture and significantly improve the content of education. Modern society is so dynamic and information-rich that teachers need to be flexible and creative, introducing new approaches and teaching methods.

Education should be proactive. Smart devices are now being actively integrated into everyday life, becoming an organic part of it. Smart watches that monitor people's health, robotic vacuum cleaners, smart plugs, TVs, lamps, and other devices that use wireless technologies are no longer a novelty in everyday life. On the other hand, if you are studying computer science, you will spend most of your time in a specialized laboratory, so it is important that your education includes the latest technological trends and techniques. By using the latest technological trends and microelectronics, computer science students who are interested in programming can gain knowledge that will be useful in practice. Programming promotes group work, creates intelligent devices that can be used for deeper research, and improves computer science education in higher education.

By exploring the capabilities of sensors and indicators of components based on the Arduino board, the ESP8266-12E WiFi module, and single-board computers, it can be concluded that it is possible to create an electronic control system using computers.

Analysis of recent research and publications

The sensors used in the smart classroom and the data collected from them can be used for demonstrations and experiments in computer science classes. The room is used to teach students computer literacy in engineering specialties. Important conditions for the implementation of interdisciplinary connections are: fulfillment of certain requirements for establishing relations between physical and mathematical disciplines and the process of studying applied programming; implementation of the principles of professional orientation of the content of physical and mathematical disciplines; formation of interdisciplinary knowledge, skills and abilities. The skillful combination of microelectronics and common methods of studying physics with programming elements has a high efficiency: a high level of assimilation of knowledge in physics and awareness of its practical application, as well as mastery of basic programming techniques and methods [1].

The analysis of technical and other literature [2-6] and our own experience with the use of information and communication technologies in the educational process suggests that the creation of a "smart" computer science classroom and the introduction of its capabilities into the teaching of higher education students is an urgent problem that requires experimental and methodological research and further study, which is the **goal** of our research.

Methods

The purpose of the study is to consider the development of a self-created smart computer science classroom in a higher education institution. The paper presents some aspects of the layout of the microelectronic elements of a smart classroom and the creation of a general algorithm for controlling the resources of a conventional computer science classroom. The research is based on the following assumptions: integration of sensors and indicator readings in the space of the computer science classroom, use of modern programming methods, and study of the process of using the created programs for the operation of the smart classroom. This approach contributes to the development of students' cognitive activity and the formation of a future programmer's view of technology. Experimental work confirmed that the best results are achieved when a student or a group of students does not just work on the quest, but independently develop it according to a certain topic from the curriculum: formulate the purpose and tasks, make a list of roles, information sources according to the chosen role; personal information search plan for the chosen topic; investigate information resources; select artifacts; make a report in the form of a presentation, publication, essay, etc.; discuss problems; represent general problem solving; evaluate the performance of tasks in accordance with the developed criteria; draw conclusions [7].

It ensures that the content of computer science is in line with the current level of development of society, scientific trends, innovations and professional orientation.

The learning space is used as a tool during lectures, presentations and laboratory work, as well as for creating and analyzing software during lectures. Software development helps to improve the conditions for raising the level of knowledge in computer science and studying the physical foundations of electronic devices, as well as algorithmization, which is important for future programmers and roboticists.

Presenting main material

In the process of studying the problem of training future teachers in the use of augmented reality technologies in education, we solved the tasks and obtained the results, the generalization of which allows us to draw certain conclusions [8]:

The created "smart" computer science classroom is an educational environment equipped with sensors that can operate in four modes: fully automated, standard, automatic, and energy-saving. The classroom can be controlled by PC, smartphone, or infrared remote control.

The intelligent tools of the computer science classroom make it possible to collect information about the environment inside and outside the classroom (temperature, humidity, pressure, light, level of carbon dioxide and other gasses in the air) and to remotely control peripheral devices: TV, projector, lighting, sockets, curtains. The developed "smart" computer science classroom consists of 3 modules: information, executive and demonstration, each controlled by a microcontroller. Pressure, temperature, humidity sensors and a barometer are used to maintain comfortable conditions in the classroom. Sensors of current (DC, AC), voltage (DC, AC), magnetic field, along with other electronic elements (resistors, coils, LEDs, motors, transistors) serve to create the most favorable and safe conditions for the operation of computers and other devices sensitive to power fluctuations, which is especially important during war and blackouts.

All three modules are connected to a wireless local area network in a star topology using radio communication based on nRF24L01 modules, the central module of which is the executive module, which in turn has access to the global network INTERNET/ The transfer of information to the office information network is provided by the Transferring() function:

```
void Transferring() {
ppp = 25;
radio.stopListening();
radio.openWritingPipe(pipe2);
radio.write(&bp, sizeof(bp));
radio.openReadingPipe(1, pipe1);
"pipe01"
radio.openReadingPipe(3, pipe3);
"pipe03"
radio.startListening();
Transferring_Serial2();
Transferring_Serial1();
Transferring_Serial3();
Transferring_Print();
}
```

Fig. 1 – code for Transferring function

Other modules send information in a similar way. Receiving information is also done by the Receiving() function in all modules, with the difference that the number of listening pipes is different:

```
void Receiving() {
delay(5);
if (radio.available(&pipeNum)) {
if (pipeNum == 1) {
radio.read(&bp, sizeof(bp));
Transferring_Serial2();
Transferring_Serial1();
Transferring_Serial3();
Comand();
}
if (pipeNum == 3) {
radio.read(&bp, sizeof(bp));
Transferring_Serial2();
Transferring_Serial1();
Transferring_Serial3();
Comand();
  }
 }
}
```

Fig. 2 – code for Receiving function

Each module can be connected to a PC via a USB port and the whole system can be controlled from the PC (using your own software). Data is transferred to the serial port byte by byte using the Transferring_Serial1(), Transferring_Serial2(), Transferring_Serial3() functions. For example, measurement data is transferred:

```
void Transferring_Serial3() {
delay(5);
Serial.write(3);
Serial.write(bp.Dosl);
Serial.write((byte*)&bp.D1, sizeof(bp.D1));
Serial.write((byte*)&bp.D2, sizeof(bp.D2));
}
```

Fig. 3 – code for measurement data transferring

The " Smart " computer science classroom is built on the Arduino platform, which allows you to combine different electronic modules of sensors and devices into a single information space. The "smart" computer science classroom is also equipped with sensors, indicators, and devices controlled by two Arduino Uno controllers, one Arduino Nano, and one ESP8266-12E WiFi module.

The readings from the built-in sensors and indicators are used for classroom demonstrations and student laboratory research. The main advantage of this method is the availability of a demonstration module for the entire information system, including the ability to create electrical circuits, use various sensors, transmit measurement data, and display research results on a large screen. The cornerstones of the classroom network topology are the executive modules that connect and control the Arduino Nano and ESP8266-12E via I2C. The digital outputs of these modules control all devices and equipment connected to the “Smart” computer science classroom. For example, the Arduino Nano controls all relays (10 of them) and can read data from light sensors, IR sensors that register remote control commands, and sensors that take readings from the external module. The ESP8266-12E module then controls the blinds. The data is sent synchronously to all “Smart” computer science classroom modules, so you can connect a computer to any of the Smart Cabinet modules via USB and use the same software to control the cabinet. In our case, the computer is connected to the information module.

The “Smart” computer science classroom software can also be used to control office equipment that is controlled by an infrared remote control, such as a TV. You can control the remote using a TV remote control or a smartphone connected via WIFI. The smartphone software is based on the RemoteXY service.

Conclusion

As a result of this understanding of the physical basics and the software part of the system, students specializing in computer engineering can get a complete picture of the demonstrated physical phenomena and the possible use of the system elements in robotics. Thus, the process of using all the capabilities of the “Smart” computer science classroom promotes a comprehensive study of phenomena and processes, stimulates cognitive activity, and motivates students to learn more about computer science and related fields that support robotics. The use of “Smart” computer science classrooms in educational institutions contributes to the formation of professional competencies, increases students' interest in studying robotics and encourages them to develop their own projects based on the Arduino platform as part of a technology club.

Involving students in the design and installation of an intelligent computer lab also broadens the horizons of technical students and helps them acquire practical skills such as assembling electrical circuits, soldering, wiring, and programming microcontrollers.

The project can be easily implemented in any computer science classroom in various educational institutions (secondary schools, colleges, universities, etc.).

In labs and lectures with engineering materials, students can study robotics more effectively by using sensors that can collect data in real time and by participating in the development of their own robotics. And group work stimulates creative projects that require skills and knowledge in physics and programming.

As practice shows, the use of smart computing classes is also the key to training highly skilled professionals not only in programming, but also in other disciplines such as physics, computer electronics, and robotics.

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