Ministry of Education and Science of Ukraine
Ternopil Ivan Puluj National Technical University

Faculty Of Computer Information Systems And Software Engineering
(full name of faculty)
Computer Systems And Networks Department
(full name of department)

QUALIFYING PAPER

For the degree of

bachelor
(degree name)

topic: **Educational Game based On Arduino Controller**
Навчальна гра на базі контролера Arduino

Submitted by: fourth year student _____, group ICI-43
specialty 123 Computer Engineering
(code and name of specialty)

_____ Sayed Ahmed M.
(signature) (surname and initials)

Supervisor _____ Yatsyshyn V.V.
(signature) (surname and initials)

Standards verified by _____ Stadnyk N.B.
(signature) (surname and initials)

Head of Department _____ Osukhivska H.M.
(signature) (surname and initials)

Reviewer _____ _____
(signature) (surname and initials)

Ternopil
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Department Computer Systems And Networks Department
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APPROVED BY
Head of Department
_____ Osukhivska H.M.
(signature) (surname and initials)
« » 20___

ASSIGNMENT

for QUALIFYING PAPER

for the degree of *bachelor*
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specialty *123 Computer Engineering*
(code and name of the specialty)

student *Sayed Ahmed M.*
(surname, name, patronymic)

1. Paper topic *Educational Game based On Arduino Controller*

Paper supervisor Yatsyshyn Vasyl Volodymyrovych, PhD, Assoc. Prof.
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2. Student's paper submission deadline 29/01/2021

3. Initial data for the paper *Type of microcontroller, type of educational game, description of* educational game

4. Paper contents (list of issues to be developed)
Introduction. 1. Analysis of subject area. 2. Hardware components of educational game. 3. Software ofeducational game. 4. Occupational safety and health. Conclusions

5. List of graphic material (with exact number of required drawings, slides)
1.Comparison of different Arduino boards. 2. Arduino electronic components. 3. Flowchart diagram of educational game. 4. System schematic of educational game. 5. Circuit schematic of educational game

6. Advisors of paper chapters

Chapter	Advisor's surname, initials and position	Signature, date	
		assignment was given by	assignment was received by
Occupational safety and			
health			

7. Date of receiving the assignment _____

TIME SCHEDULE

LN	Paper stages	Paper stages deadlines	Notes
	Analysis of technical task		
	Analysis of subject area and educational game		
	Hardware components of educational game		
	Softwareof educational game		
	Occupational safety and health		
	Graphic materials		
	Preparation to the qualification work presentation		
	Qualification work pressentation		

Student _____ Sayed Ahmed M.
(signature) (surname and initials)

Paper supervisor _____ Yatsyshyn V.V.
(signature) (surname and initials)

ABSTRACT

Educational Game based On Arduino Controller //Qualifying paper //Sayed Ahmed// Ternopil Ivan Puluj National Technical University, Fac-ulty of Computer Information Systems and Software Engineering, group ICI-43 //Ternopil, 2021 // p. – 64, fig. - 27, tabl.– 2, code snip. –7, append. – 1, bibliogr. – 18.

Keywords: Arduino, Microcontoller, IoT, LED, BreadBoard, C/C++, System.

In this diploma thesis I learned how to use Arduino board and programe it to make a memory game, games are one of the best ways to learn now a days and it has been recently considered as a electronic sport in many countries, and the main goal of this work is to help people like me with short memory to train their memories in a fun way via mixing learning and playing to bring joy to the learning methods, and simplicity was always the key to many big projects and thoughts.

CONTENT

INTRODUCTION

Microcontrollers(MCU) are compact computer-units(CPU), created for ingrained systems and integrated devices based on IC (integrated circuit) chips. MCU are used to automatically monitor items and devices in contrast with microchips in personal PC's. Examples are Control systems found in the engines of automobiles, Remote Control Systems, 3D printers, Control Tools and Toys, etc. Electronic goods begin to decline as processing prices, and MCU's are everywhere in our everyday lives. It is important that you can use them as a prototype.

Many microcontroller kits are available on the market for different uses, but all microcontrollers are the same, and they are fitted with a central processing unit, computing memory, data memory, and programmable peripherals for input and output. While some internal clock controls are available, most settings require external clock components isolated from the IC package, since they are normally more reliable. This is a map of the fundamental components of the microcontroller.

Arduino is an electronic development board that consists of an open source electronic circuit with a microcontroller on a single board that is programmed by the computer and is designed to make the process of using interactive electronics in multidisciplinary projects easier. Arduino is mainly used in designing interactive electronic projects or Projects that target building different environmental sensors (such as temperature, wind, pressure, etc.). The Arduino can be connected to different programs on the personal PC. Arduino relies on programming it on the open-source programming language, processing, and the programming codes for the Arduino language are distinguished by that they are identical to C ++ programming language and are considered one of the easiest programming languages used in writing microcontroller programs.

Throughout the years, Arduino has gone from daily artifacts to In the minds of thousands of projects, innovative research methods. This free access network pulled together and added to The overwhelming amount of expertise open to novices

as well as practitioners , the worldwide creative world – instructors, antiquarian, designers, engineers and practitioners.

The story begins in 2005 in the Italian city of Ivrea, where Massimo Banzi, in cooperation with David Cuartielles and Gianluca Martino, launched the Arduin of Ivrea project, and the project was named after the most famous historical figure in the city. The primary aim of the project was to build a 100 percent open source development environment for microcontrollers. for microcontrollers, which is free at the same time. It also included the work of small-sized development boards at a low cost, which currently amounts to about $ 27 to be able. Students and techies bear the price, and as of 2013, more than 700,000 Arduino boards had been shipped. Since entering a broader public To adapt to new uses and problems, Arduino has continued to evolve its products, from basic 8-bit boards to IoT applications., wearables, 3D printing, and sustainable products. Both Arduino development boards are entirely open sources that allow users to build and respond to their individual needs independently. The app is also free to use and is active with users around the world.

Game learning has grown in importance. Children will enhance their imagination and listening skills via games, Playing and gaining significant reasoning ability, and boost their potential development. This is a indispensable component of a memory jigsaw. Everybody has tried or was a part of any kind of memory games at some stage. If this is the distinction, just a cards matching games or jigsaw puzzle. Both games can be completed via players memory, using this method, users evolve their core competencies. And this is how reminder games can grow and boost children's memory:

– Many brain functions can be enhanced by memory games including alertness and focus. Memory games give cognitive reasoning space, encouraging children to reflect on facts.

– Memory games can improve object recognition. The children establish distinguishability in many story games by seeing combinations or fusing two images. The contrast between the images is faster.

– Short-term memory is an important aspect for memory gamers, enhancing their working conditions in the industry too. The long term memory of an individual can also be improved by good memory. Both interrelated and can improve learning to transfer objects from short to long-term memory in several respects.

– At short-term speeds, players have to prepare how to play and think, when memory games are.

1 ANALYSIS OF SUBJECT AREA

1.1 Analysis of technical task

Main objective of the diploma project is to build game for training children's memory. Project will be based on Arduino Uno R3 board.Input documents for system development:

- specification of Arduino Uno R3;
- specification of lights;
- specification of buttons;
- specification of buzzer;
- specification of Arduino Uno R3 firmware;
- documentation of Arduino IDE.

Arduino Uno is a microcontroller-based computer (data sheet). Includes all required for the microcontroller's operation:14 optical outputs, including 6 as PWM outputs; 6 analog inputs; 16 MHz crystal resonator; one USB connector and one battery connection; one ICSP button and a reset. To continue using the device, it must be installed on the machine using a USB cable or only the AC/DC adapter or battery.

Arduino Uno R3 is one of the most common microcontrollers of Arduino today. It has a huge, thousands of online community-produced projects. If you want to monitor the temperature and humidity outside the house or allow the Arduino to automatically balance the robot, In several DIY implementations, the Arduino products are universal. benefits of using Arduino :

Cheap: In comparison to other mcu's, Arduino mcu's are Comparably cheap.

- works for all platforms: the Arduino (IDE) programming system operates on many operating systems such as Windows, OSX and Linux. In comparison to most micro - controller devices, they are only for Windows.

– Quick and transparent programming system: Arduino app (IDE) for newbies is easy to use but versatile enough to enable experienced users to use it too. For instructors, the programming environment is easily oriented such that students who learn to program in this system know how the Arduino (IDE) works.

– Open source software: Arduino Software is available to experts as an open source tool. You can extend the vocabulary by means of the C++ library and if you would like to hear about technical details you can use this langue in order to switch from Arduino and AVR C and vice versa.

– The hardware structure is quick and fast to implement, but the hardware system must use as powerful as possible by gaming logic and levels with the open hardware tools.

– via changing the system program of the one-board computer and external parts, the function and flexibility of the system can be assured.

Consistency and the position of each part that must be rendered to attach each button to its Lead and move the actions and the reactions through the device.

To diagnose the system, the necessary software used in the respective system software must be tracked. The tools can provide a simple platform for displaying and tracking medical events.

Device managers control and monitor the system remotely or manually. The minimum number of employees is one male.

In the following cases, the machine must be operational and restored:

– if the hardware starting system power system fails, it triggers a reboot;

– confuse the OS to recover device functions when a hardware process mistake happens (excluding data carriers and programs).;

– computer bugs errors (operating system and device drivers). Using network filters and interruptible power supplies to protect the devices from overvoltage and switching disruptions.

The system must be able to scale:

– by productivity;

– bycapcity of information process;

The basic software and hardware used for scaling functionality must be given.

The exterior elements of the system's technological behavior under voltage, must have protection against accidental contact, and the technical measures themselves must have a zeroing or protective grounding. The power supply system must provide a protective switch during overloads and short circuits in the load circuits, as well as manual emergency shutdown. General fire safety requirements must comply with the standards for household electrical equipment. In the event of fire, no poisonous gases or vapors should be produced. After disconnecting power provision, ensure that all fire extinguishers can be used.

For normal operation of the network it is necessary to support:

– air temperature in the range from + 15C to + 20C;
– relative humidity at 20C in the range from 30% to 70%;
– atmospheric pressure 760mm Hg.

The technical means used must be regularly maintained according to the requirements of the technical documents, but not less than once a year. Regular maintenance and testing of technical means should include maintenance and testing of all used means, including workstations, servers, cable systems and network equipment, and uninterrupted power supplies. According to the test results of technical means, the reasons for the defects should be analyzed and eliminated. The location of the premises and its equipment must prevent uncontrolled entry by outsiders and ensure the security of confidential documents located in these premises and technical means.

Requirements to the system’s hardware (technical characteristics of each devices in the system):

1. Single-board computer with low power consumption and the ability to control hardware.

2. USB cable for PC connection

3. Push tact buttons to select each LED

4. LED to light in certain order for the game

5. Prototyping board to connect the components

6. 220 Ohm resistors for the LED to light

1.2 System components justification

1.2.1 Main components for modelling

Arduino is a versatile and straightforward electronic prototyping tool for open source applications. It is ideal for musicians, programmers, connoisseurs and whoever wants immersive activities, or load any programming essentially, sensor read, act with the input button, monitor and embrace the cover for extending your job. In reality, you will virtually do it all.

One feature in congruous is that they are configured to use Arduino IDE in every Arduino board. This can be achieved by writing and uploading code programs. Moreover, there might be plenty variants. There are only those considerations (number of sensors, LEDs and buttons that are attainable on a table) The rpm, working voltage, and form factor are the number of inputs and outputs. (hardware). Others can operate undeviatingly from a 3.7V battery, others need a minimum of 5V. Next page you can see the difference between different Arduino boards.

Table 1.1 - Comparison of different Arduino boards

Item	System Voltage	Clock Speed	Digital I/O	Analog Inputs	PWM	UART	Programming Interface	Cost
ATmega328 Boards — 32kB Program Space // 1 UART // 6 PWM // 4-8 Analog Inputs // 9-14 Digital I/O								
 Arduino Uno - R3	5V	16MHz	14	6	6	1	USB via ATMega16U2	$29.95
 Arduino Uno R3 SMD	5V	16MHz	14	6	6	1	USB via ATMega16U2	$29.95

 RedBoard	5V	16MHz	14	6	6	1	USB via FTDI	$24.95
 Arduino Pro	3.3V	8MHz	14	6	6	1	FTDI-Compatible Header	$14.95
 Arduino Pro	5V	16MHz	14	6	6	1	FTDI-Compatible Header	$14.95
 Arduino Mini 05	5V	16MHz	14	8	6	1	FTDI-Compatible Header	$33.95
 Arduino Pro Mini	3.3V	8MHz	14	8	6	1	FTDI-Compatible Header	$9.95
 Arduino Pro Mini	5V	16MHz	14	8	6	1	FTDI-Compatible Header	$9.95
 Arduino Ethernet	5V	16MHz	14	6	6	1	FTDI-Compatible Header	$59.95
 Arduino Fio	3.3V	8MHz	14	8	6	1	FTDI-Compatible Header or Wirelessly via XBee†	$24.95
 LilyPad Arduino 328 Main Board	3.3V	8MHz	14	6	6	1	FTDI-Compatible Header	$21.95

 LilyPad Arduino Simple Board	3.3V	8MHz	9	4	5	0‡	FTDI-Compatible Header	$19.95

Figure 1.1 displays main electronic components.

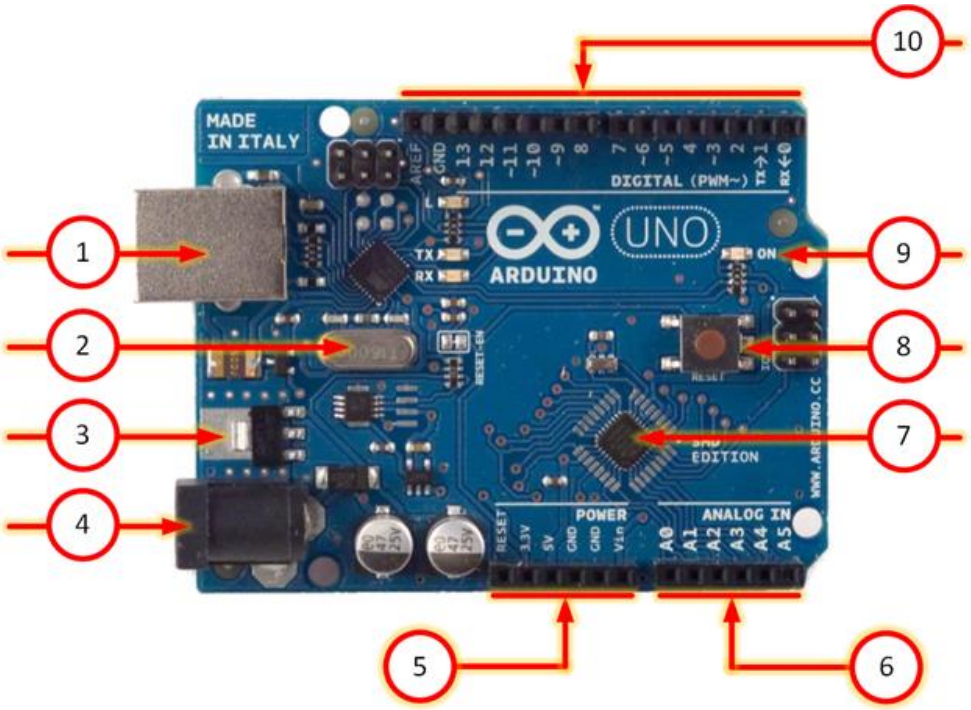

Fig 1.1 – Arduino electronic components

The numbers in the figure above refer to the electronic components, we will explain each element based on its number in the following points:

1. A USB Type B port that is connected to the computer, feeding power to the board, as well as through which the microcontroller can be programmed.

Noticeable:

As you know, these lessons focus on simulating the Arduino using the Proteus 8, and in the Proteus you will not need to deliver any power to the board as the Proteus implicitly performs this operation.

2. A crystal oscillator used to generate 16MHz pulses. The microcontroller cannot execute the program without the oseliter. Each instruction within the program

is executed with a specified number of pulses. The oseliter is also used to control time and control time-related processes (it will be identified later).

3. It is used to ensure the working voltage within a specified range.

4. Another Power Barrel jack type, the input is recommended to be between 7 to 12 volts.

5. A group of 6 outlets connected to the power is as follows (from right to left):

Vin: Another port used to power the Arduino board from an external source

GND: A port that can be used to connect the ground that belongs to an external device to the ground that belongs to the Arduino, and this is implemented if this device took the power from the Arduino board or from the same source that the Arduino was taken from.

5v: a voltage source that can output 5 volts that can be used to power external devices.

3.3v: a voltage source that can output 3.3 volts that can also be used to power external devices.

Reset: used to restart the program.

6. Atmega328 microcontroller.

7. A button used to restart the program.

8. LED indicates that the power supply is working properly.

9. A group of 16 ports, which we explain in the following points (from right to left):

Ports 0 to 13 are used as input and output ports for digital signals (Digital I / O) and cannot be used with analogue signals.

Ports 0 and 1, in addition to serving as an input and output for digital signals, can be used with the serial interface.

The ports with the symbol ~ can be used as a PWM - Pulse Width Modulation 6 ports.

GND: As explained earlier, this port is connected to circuit earth.

AREF: used to specify the highest voltage to be received from an analog signal, AREF is the abbreviation for Analog Reference.

1.2.2 Breadboard

A breadboard is a weld-free device for the installation of temporary printing prototypes for machines and test circuits. Through mounting their conduits or terminals, most electrical instruments can be attached to the hole and connected to the electronic circuits by wiring at the correct location. Under the panel at the opening, the door is mounted with metal bars. The orientation of the metal bars is shown by this diagram. Know that the cavity's top and bottom are horizontally attached to the base of the rest of the hole.

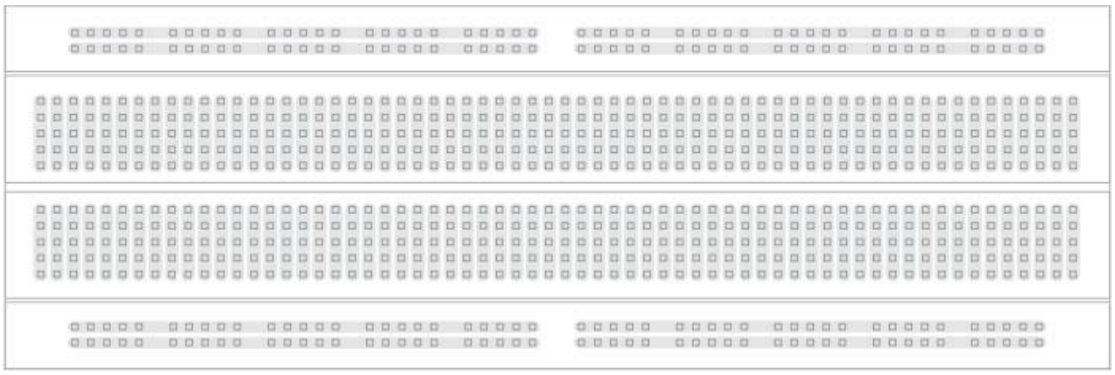

Fig 1.2 – Breadboard

1.3 Software justification

When creating an electronic project, you need to make the interactive electronics and control capabilities of this project easier and simpler, and therefore we use the Arduino programming language because it is open source and you can do through the required tasks, but these things are only done through some components And aspects, which are represented in the following points:

Arduino depends on open sources, which in a simple brief can be considered all the subtle and large details, whether about the programming language or design

used in a project so that other people can identify these details and benefit from them, the idea of open source is the main reason for the spread of these Language in many projects saves you a lot of time and it also provides a community of programming experts to share.

The Arduino language is a language of communication and communication between the user and the various electronic devices so that these devices carry out the required commands, and the Arduino language depends on a board dedicated to it to do this called the “Arduino board”, through the Arduino program and by the method of the Arduino language that you will enter In this program it will start performing the required tasks on the board.

Your QuillBot will rewrite the file. As a result of its easily operated by the user interface, In multiple packets Arduino was used and programs. Begin by writing or pasting something here and then click Par. For beginners, the Arduino software is easily operated, but is sufficiently stable for experienced programmers. It works on Mac, Linux and Windows. This technology is used by tutors and learners to construct affordable science equipment or to illustrate fundamentals of both chemistry and physics, or to begin artificial intelligence and programming. Engineers and developers create immersive projects that introduce performers and designers to experimental Instruments of music and test them. For one thing, it can definitely be used by producers to create some of the designs of Maker Faire. The Arduino is a critical learning tool for new things. The intermittent directions of the kit for shopping or online sharing of thoughts with other Arduino Project members can be followed by teenagers, hobbyists, designers, programmers.

Advantages of using Arduino:

– Simplicity: the Arduino is designed to fit everyone's needs, professionals, professors, students and interactive electronics enthusiasts.

– The price: The Arduino board is less expensive compared to other boards of the same type, so the price for the most expensive Arduino does not exceed $ 50.

– Self-Assembly: You can download the Datasheet for Arduino for free from the official website and buy and install the parts yourself!

– Multiplatform: The Arduino program has the ability to work on Windows, Mac OS, and Linux, and most other electronic controllers only work on Windows.

– Simple and easy programming environment: the programming environment is designed to be easy for beginners, stable and robust for professionals.

– Open Source Software: Written in C ++, available for everyone to download, and programmers can modify it according to their needs.

– Open Source Hardware: The Arduino is mainly made of ATMEGA8 and ATMEGA168 controllers and the schematics are published under Creative Commons license allowing electronic circuit designers to design their own circuits.

Now, we understand that the Arduino is the perfect tool for designing and introducing new products. We have studies on the functioning and operation of different types of Arduino microcontrollers. We also understand Arduino's hardware and software capabilities. For industrial use, the Arduino microcontroller is used to regulate the speed of motors. For robotic applications, the most appropriate

2 HARDWARE COMPONENTS OF EDUCATIONAL GAME

2.1 Hardware component justification

2.1.1 Arduino UNO R3 controller

The Arduino is in two parts built: hardware and software, Hobbyist, builder, hacker, creator, novices, and everyday else Interesting in designing immersive projects or communities. It will communicate with your tablet, smartphone, or TV, with keys, LEDs, engines, microphones, GPS satellite systems and cameras.

This flexibility in interaction in addition to the free software and hardware of the Arduino is inexpensive, and the convenience to use the hardware and applications of Arduino, Everything this led to a large group of users from Arduino who had written code and tutorials for a wide variety of Arduino projects.

The first page was designed for the initial design of the design, and he is able to do this in order to do electronic projects without the need for much technical knowledge, from here, Arduino covers or what is known as Arduino shields are designed and manufactured

Cover: an electronic board the same size as the Arduino and placed on the electronic keyboard.

To make anything electronic, such as robots or all different things, Any electronic project may use Arduino as a mindful brain.

To control the temperature of the "smart home" it is proposed to use an Arduino UNO microcontroller with a Wi-Fi module ESP8266. This Wi-Fi module contains 8Mb of flash memory.

A feature of the Arduino UNO + Wi-Fi R3 is that the two parts of the Arduino UNO and ESP8266 can work simultaneously or independently of each other.

Arduino UNO is characterized by such parameters as the type of microcontroller (ATmega328), the presence of fourteen digital and six analog inputs / outputs, operating voltage in the range 6V-9V, 16MHz and 32Kb flash memory.

The main characteristics of ESP8266 include:

– support for data transmission protocols 802.11 b, 802.11 g, 802.11 n;
– 8 MB memory size
– support for the built-in TCP / IP protocol stack;
– power of 20.5 dBm when using the 802.11b protocol;
– availability of power management system;
– sending data packets in the range up to 22 ms;
– standby power consumption up to 1 mW.

The ports of the Arduino UNO are digital inputs / outputs, which are shown by pins from 0 to 13. The level of the logic unit corresponds to a voltage of 5 V, and accordingly to the logic zero - 0 V. The maximum output current is 40 mA. Resistors are also connected to the contacts, as they are included by default, but if necessary, they can be disabled at the software level.

Outputs "3", "5", "6", "9-11" are responsible for pulse-width modulation (PWM), which allow to output analog values in the form of a width-modulated signal.

In order to remove the analog signal, inputs A0 – A5 are used, each of which in 10-bit form can represent an analog voltage. The bit-to-analog-to-digital converter is 10 bits, respectively.

For interacting with peripherals over a TWI/I2C network, SDA and SCL inputs are used. The protocol is synchronous with data transfer. Very commonly, Wire.h is used when operating with device peripherals.

Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK) interactions are supported by the SPI interface and a library of the same name is used concurrently.

The USB-UART, which is attached to the respective microcontroller outputs, are translated with the RX and TX ingots/outputs. These foams are used while the Arduino board connects via the Serial Class with a PC or other computers.

In the fig. 2.1displays the Arduino UNO R3 electric circuit diagram.

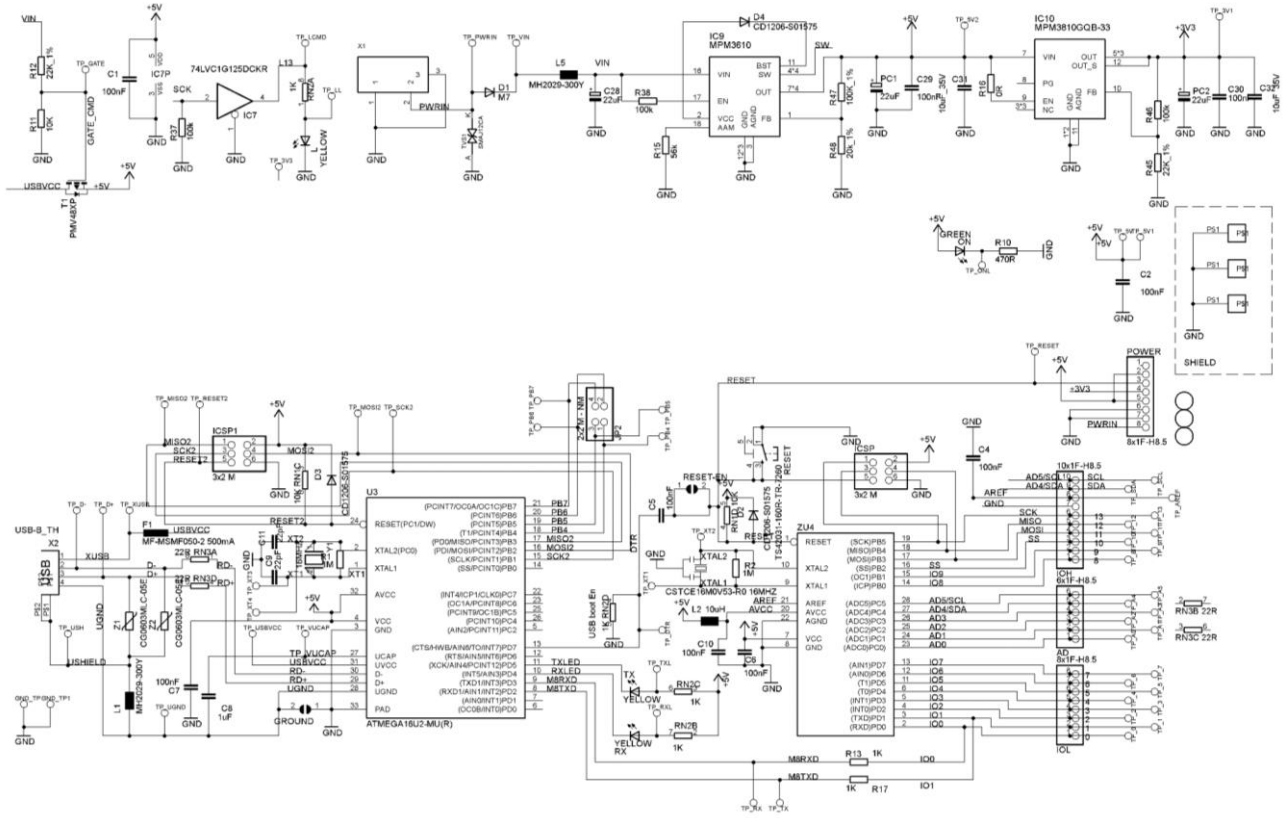

Fig 2.1 –Schematic electrical principle Arduino UNO

The main function of the ATmega16U2 microcontroller is to ensure that the ATmega328P communicates with the computer's USB port. In this case, the Arduino Uno WiFi R3 emulates the operation of a virtual COM port when connected to a computer, and eliminates the need to use third-party drivers.

To power the test chip use the following foams:

– VIN - voltage may be supplied or consumed from an external power source that is not connected to the appropriate voltage rating of the USB port;

– 5V - from the board stabilizer a voltage of 5 V is supplied to this pin, which provides power to the ATmega328 microcontroller (it is not necessary to power other devices from 5V);

– 3.3V - from the voltage regulator of the board the voltage with the corresponding face value and the maximum output current of 1 A moves;

– GND - designation of the conclusions of the "earth".

– IOREF - information output for expansion cards on the operating voltage of the microcontroller, which allows you to switch to other power sources or use

voltage level converters for the operation of devices powered by both 3.3 V and 5 V.In fig. 3.4 shows the electrical circuit diagram ESP8266.

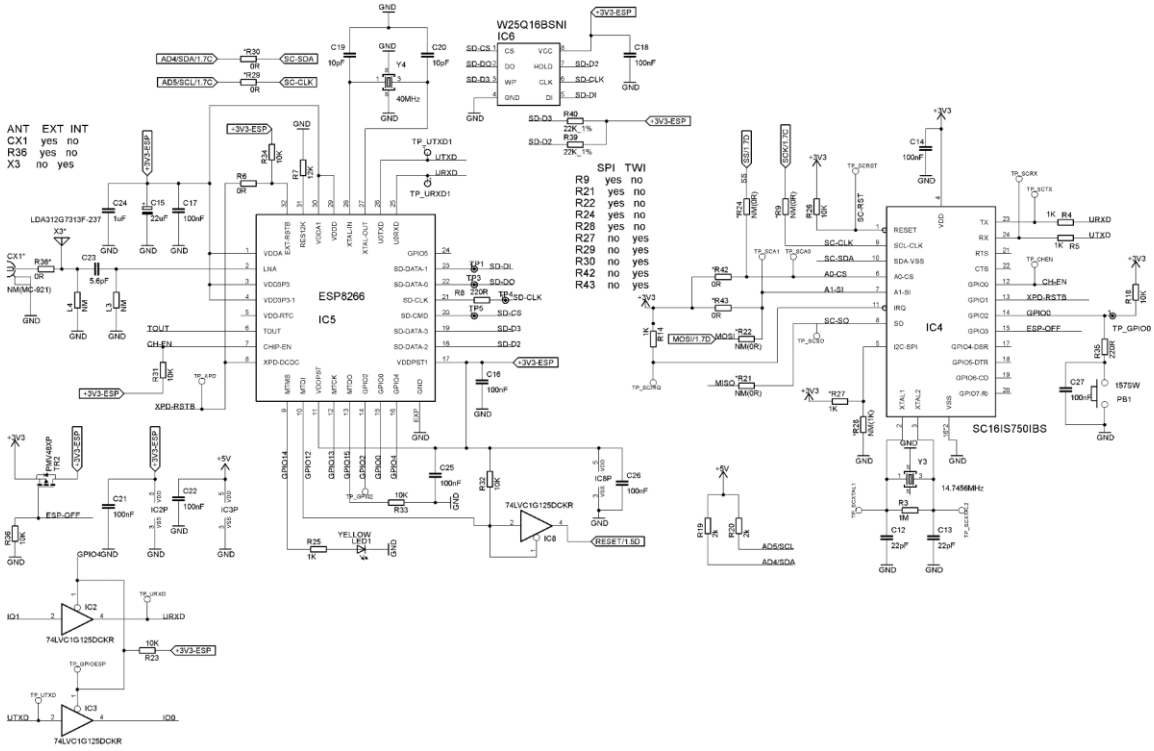

Fig 2.2 –Schematic electrical diagram ESP8266

2.1.2 LED

It has 1.8V working voltage and 10mA-20mA working current. A 5 V or 3,3 V voltage can be supplied by the Arduino Uno module.

The LED is used as the system's principal visual component.

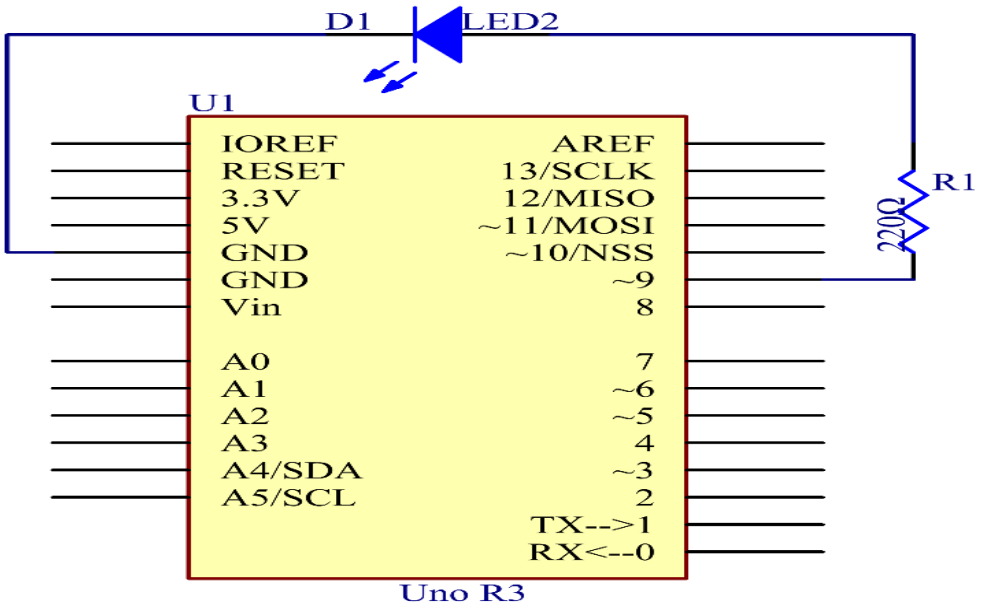

Fig2.3 –Schematic diagram

2.1.3 Resistor

Resistors are used to limit the current amount that goes to certain components in Arduino circuit like LED (fig. 2.4).

Fig 2.4 – Resistor

2.1.4 USB cable

The USB is connected to the vin in the system to run it through an external power source or supply (fig. 2.5).

Fig 2.5 – USB cable

2.1.5 Jumper wires

Jumpers are used to establish connections between the objects on the breadboard and the headers of the Arduino (fig. 2.6).

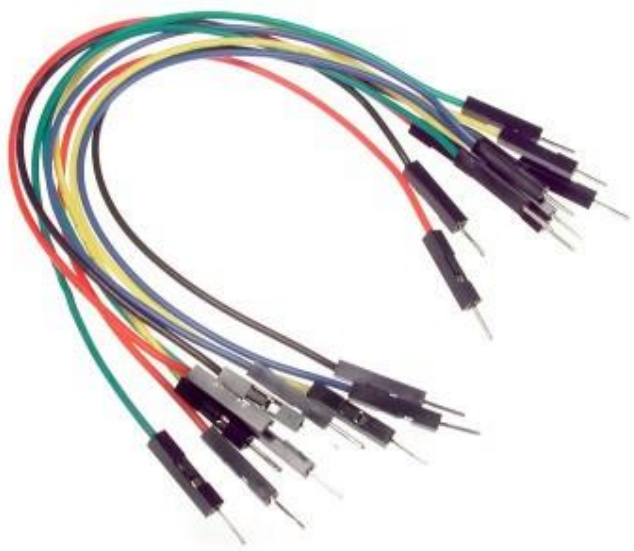

Fig 2.6 – Jumper wires

2.1.6 Push Buttons

A button or switch connects two points in the circuit when pressed (fig. 2.7).

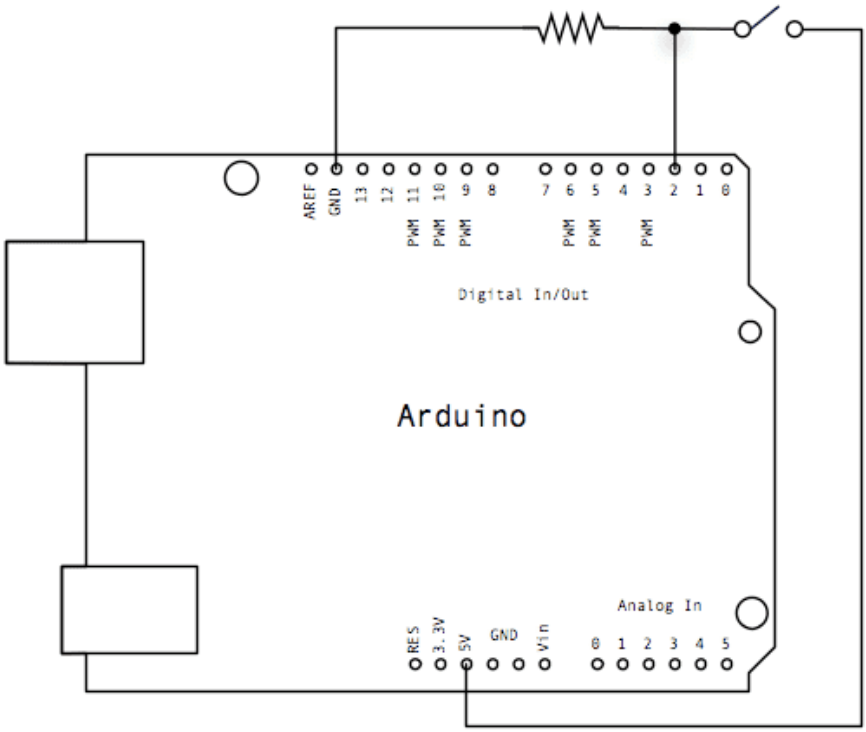

Fig 2.7 – Push Buttons schematic

2.2 The build of the system and its structure

The pushbuttons will be placed in the breadboard so that they are straddled on middle break with A and B contacts on one side of the break , so it will be for C and D as in the figure 2.8.

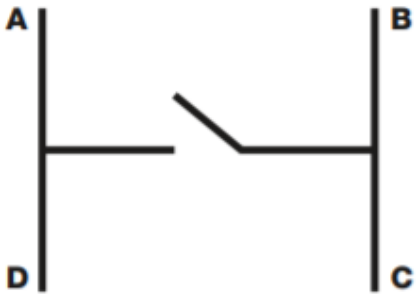

Fig. 2.8 – Push buttons connection

Pin B is linked to the GND rail on the breadboard by each push-button, and the rail is connected to the GND Arduino.

Pin D will be attached from 2 to 5 on each pushbutton to Arduino digital pins.

All he LED’s bound by the negative short leg with point C of each bell, while the positive leg of the led is connected to the hole to the right of the negative leg (fig. 2.9).

PUSHBUTTON	ARDUINO/LED
Pin B	GND
Pin C	LED negative legs
Pin D	Arduino pins 2–5

Fig. 2.9 – Circuit diagram

The resistors with 220 ohm are connected with one wire to the positive portion of the leds and the other wire to the Arduino. The resistors are connected with one wire (fig.2.10).

LEDS	ARDUINO/ PUSHBUTTON
Positive legs	Arduino pins 8–11 via 220-ohm resistors
Negative legs	Pushbutton pin C

Fig. 2.10 – The resistor connection diagram

The red wire is attached to the Arduino pin (), the black piezo wire to the Arduino GND (fig. 2.11).

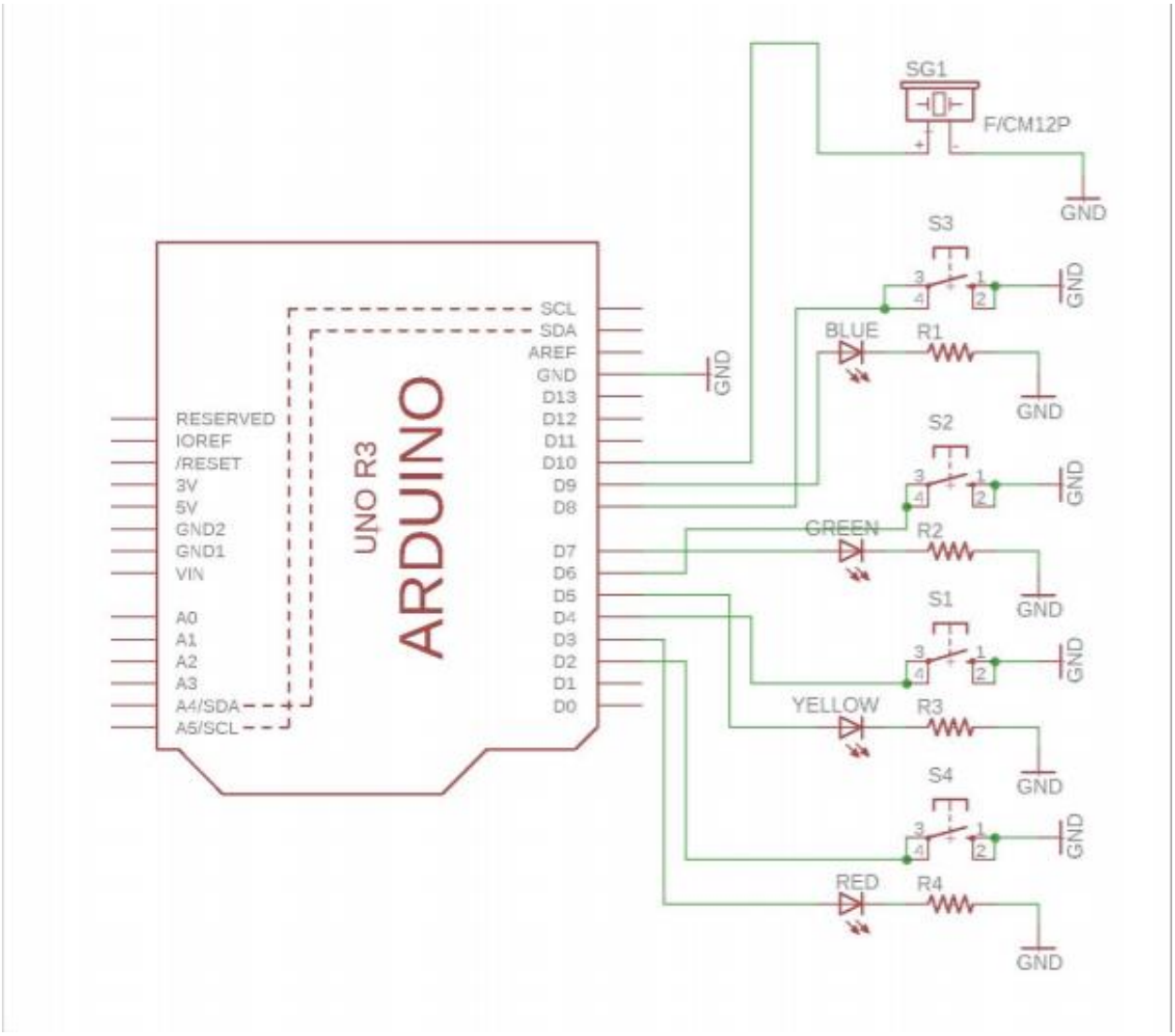

Fig. 2.11 – Circuit schematic of educational game

The game challenges recall by naming 4 LEDs in various colors and tones randomly.

The summary is that in a certain random sequence, the four LED indicateurs flash, and the players can follow the same pattern to upgrade the game and win. If the player enters the wrong pattern, the game is lost and a new pattern is launched. Memory games will help our memory strengthen. Then try playing recall games to help boost memory and concentration next time you play a video game (fig. 2.12).

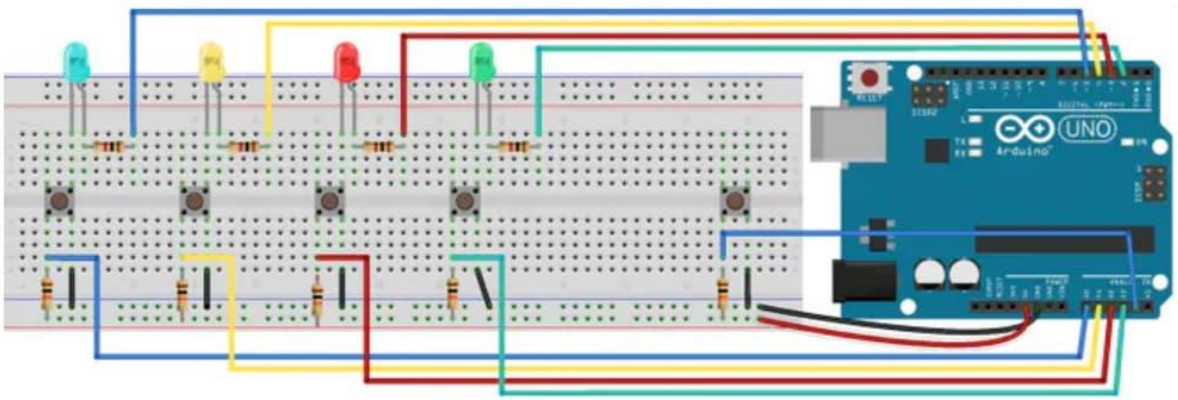

Fig. 2.12 – System schematic

We understand Arduino's operating theory, its hardware/software capabilities and its implementations in this paper as to where it is actually being used and where it can be used. We also knew how to compose illustrations for Arduino in their own IDE (software). It is endless to generate new concepts with Arduino, and with the aid of this paper we have learned to design our own creative devices to produce and execute revolutionary things. The possibilities of using an Arduino to learn and create new concepts are endless, from wearable apparel to space science. While it has its own drawbacks, it is a marvelous instrument that can be used in studying.

3 SOFTWARE OF EDUCATIONAL GAME

3.1 Analysis of Arduino (IDE)

What is the value of the Arduino board and its components, if not able to carry out a useful and efficient command? So, this board must be programmed, and a program must be loaded that directs the microcontroller and all the parts and components connected to the Arduino board to perform the function that the user and the developer want. This is actually the essence of the goal of the Arduino board, that is, to make it available to any programmer to be able to write programs and install them on the board, in order to perform a useful function in a field.

Each Arduino code must contain the following two functions:

`setup ()`

The setup () function is called first when starting to execute the code (called sketch as it is called Arduino), as it is used to configure variables, leg positions, interfaces, start using libraries, etc. Note that the setup () function will only be executed once after the Arduino board is turned on or reset.

`loop ()`

After creating the setup () function that initializes and configures the initial values to be used, the loop () function "duplicates" the code written inside it - exactly as its name indicates - respectively, allowing your program to control the Arduino board and change and respond to the environment and associated elements.

`break`

The break keyword is used to exit the iterative for, while, or do ... while loops, as it skips the following code and the terms of the specified loop. Also used to exit the switch ... case programming expression.

`continue`

The continue keyword skips the code that follows it in the iteration loop (such as for, while, or iterative do ... while loops) to validate the conditional expression of that loop and then the iteration loop resumes normally.

`dowhile`

The iterative do ... while loop works the same way as the while loop, except that the condition is checked at the end of the loop and not at the beginning. This means that the loop will be executed at least once.

else

The if ... else conditional expression allows for more extensive control over the verification sequence of several specific conditions when the code is executed, rather than checking for a single condition when using the if expression. The else statement (if present) will be executed if the condition given in the if statement is not fulfilled (i.e. it gives false). The else statement can also be used in conjunction with the if statement in the form of else if to add another condition to verify so that several consecutive checks can be performed simultaneously.

for

The for loop is used to iterate a specific block of code a specified number of times. Typically, this loop is used as a counter to keep track of the number of times a code is repeated and interrupted when a specified number is reached. The for loop can be used with any iteration operation, and it is frequently used with arrays to execute a specific operation on its elements, which may be regular data or specific legs.

goto

The goto keyword moves the program to a specific location in the code.

if

The if expression checks a specific condition and executes the block written within it if it is true (i.e. its value is true).

return

The return keyword intersects the execution of any function and returns a value from the function to whoever called it, if specified.

switchcase

The expression switch ... case checks - as in if - a specified value in a way that allows the programmer to specify several codes, one of which would be executed based on that value being checked.

while

The while loop repeats the execution of the block within it continuously and infinitely as long as the value of the logical condition in the parentheses is true (see the general evidence in the loop documentation); Whenever the logical condition value becomes false, the loop stops and exits.

In order for the Arduino to be programmed, a special IDE was assigned to it. The environment was developed based on the Java language to be a programming environment that supports C and C ++ languages. The programming environment for Arduino boards in the Arduino C language is called the Arduino C environment is a free, open-source environment that includes many efficient offices that a developer may need while working. In addition, it has a large number of joint developers in the Arduino community, who They periodically add projects and applications, so that they are freely and completely available to anyone who wants to implement a program or technical project using the Arduino board.

Arithmetic transactions

Arithmetic Operators perform the four basic arithmetic operations (addition, subtraction, multiplication, and division) in addition to other operations such as computing remainder and assigning values to variables.

Budget transactions

Comparison Operators perform a balancing process - as it is called - between two values or two variables or a variable and a certain value, then return a logical value that represents the state of one of the two parameters (greater, smaller, equal ... etc.) relative to the other.

Boolean operators

Boolean Operators perform logical operations (AND operation, OR operation, or NOT operation) on values or logical expressions and then return the resulting logical value.

Indicator access transactions

Pointer Access Operators are the parameters that are used with pointers to provide access to and reference to the addresses of variables in memory, and the ability of variables to access the values contained in the memory addresses referred to by the pointers.

Binary number operators

Bitwise Operators perform all logical operations and offsets on number bits and binary values and then return the resulting value.

Compound transactions

Compound Operators are used in coding in Arduino a lot for zeroing, tuning, and flipping specific bits in binary values and other important operations that greatly facilitate and simplify the coding process.

3.2 C programming language justification

Why C ? For people who have a good programming background, especially in C and C ++ languages, they will find the Arduino C environment easy and fun, and they won't have any difficulty dealing with it. For people who do not have a good programming background, there is no need to worry or fear, the environment is easy, and anyone can learn it easily, and you can also adopt it as a first step towards starting to understand the world of software and programming languages and to communicate with hard hardware. Finally, and as an important feature especially for users and developers who use AVR controllers, the program written in C can be installed directly on the Arduino board.

3.3 Alghoritm of educational game

All of the LEDs will glow on the circuit and play a melody. It will flash the first light in the pattern after a few seconds. If you correctly repeat the pattern by clicking the corresponding color button, the game advances to the next round and adds another color to the series of patterns. When you make a mistake, the tone of defeat plays out.

If you get to round 10, you will hear the winning tone. Then you start a new game by pressing any button.

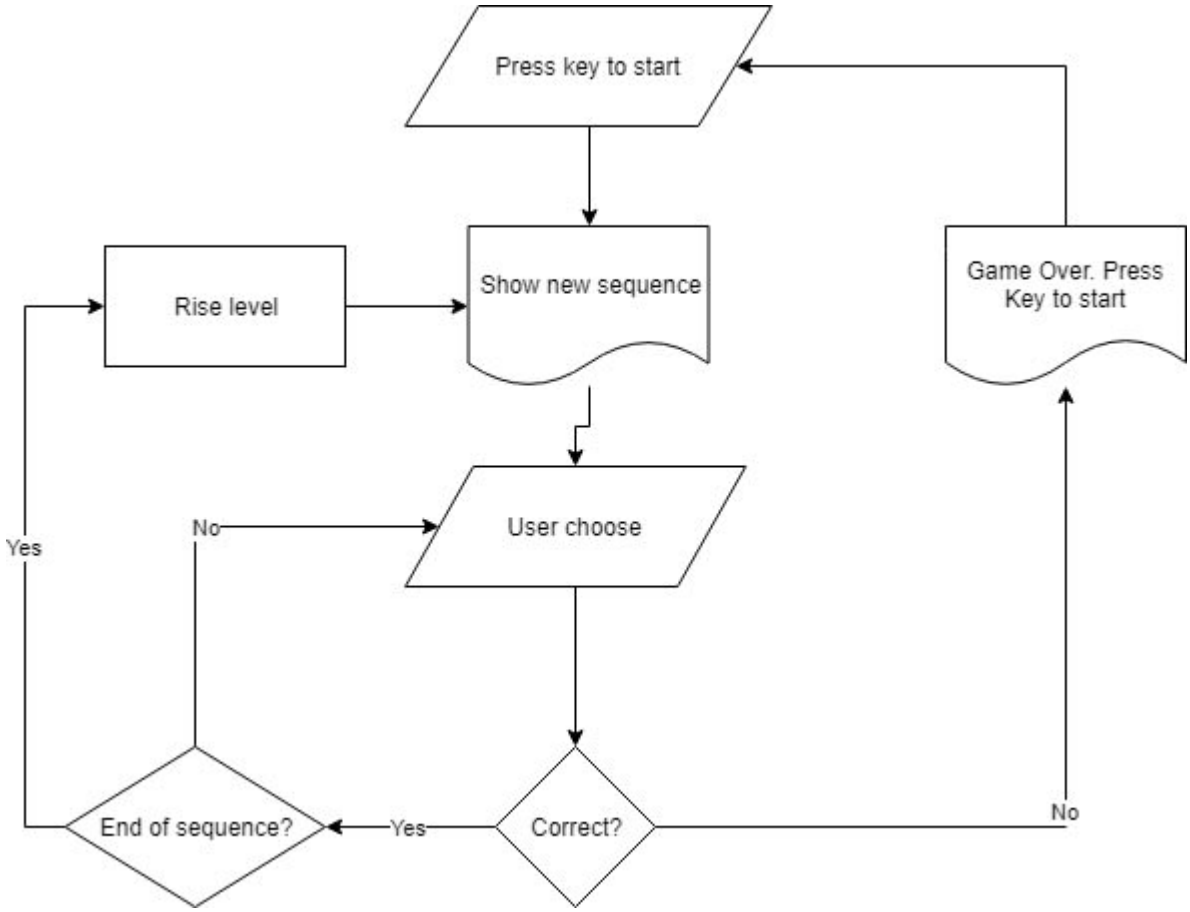

Fig. 3.1 – Flowchart diagram

3.4 Sofware components

The circuit flashes the entire LED and plays a melody. It flashes the first light in the pattern after a few seconds. By clicking the appropriate colored button, the game will progress into the next round, adding a color to the pattern sequence. When you repeat the pattern correctly. The Failure Melody is going to play if you make a mistake. The win melody is played if you hit round 10. To start a new game, press any button. Figure 3.2 displays bread with buttons and leds.

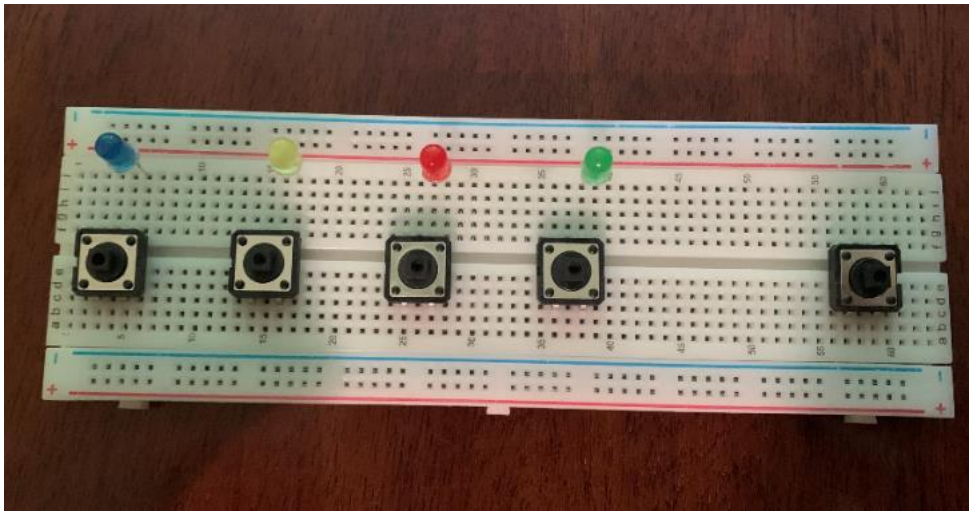

Fig 3.2 – Bread with buttons and leds

Programming code for buttons and leds initialization presented below.

```
int button[] = {2, 4, 6, 8};  //red is button[0], yellow is
    button[1], green is button[2], blue is button[3]
int led[] = {3, 5, 7, 9};     //red is led[0], yellow is led[1],
    green is led[2], blue is led[3]
int tones[] = {262, 330, 392, 494};   //tones for every button
    (c, e, g, b)

int roundsToWin = 10;         //number of rounds to win the game
int buttonSequence[16];       //make an array of numbers that
    will be the sequence that the player needs to remember

int buzzerPin = 10;           //pin to show that the buzzer is
    connected

int pressedButton = 4;        //a variable to remember which
    button is being pressed. 4 is the value if no button is
    being pressed.
int roundCounter = 1;         //tracking the rounds


long startTime = 0;           //timer variable for time limit on
    button press
```

```
long timeLimit = 2000;        //time limit to press the button

boolean gameStarted = false;      //variable to tell the game
    whether or not to play the start sequence
```

When the program begins, the setup() function runs. It is used to initialize the initial properties of the environment (fig. 3.3).

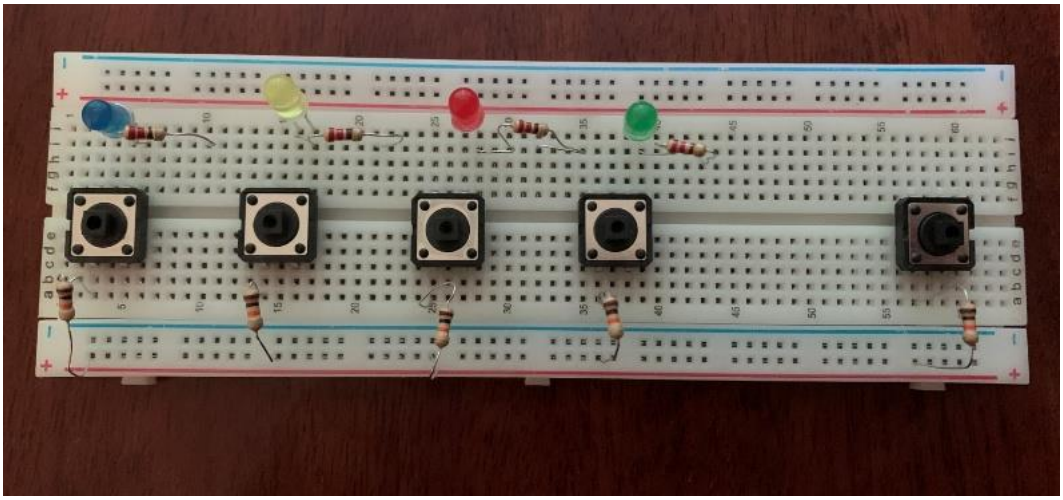

Fig 3.3 –The initial properties of the environment

Programming code to initial environment presented below.

```
const int MAX_LEVEL = 100;
int sequence[MAX_LEVEL];
int your_sequence[MAX_LEVEL];
int level = 1;
int velocity = 1000;
```

This part of the code is to identify the constants in the code and to set the game levels

```
void setup() {
pinMode(A0, INPUT);
pinMode(A1, INPUT);
pinMode(A2, INPUT);
pinMode(A3, INPUT);
```

```
pinMode(2, OUTPUT);
pinMode(3, OUTPUT);
pinMode(4, OUTPUT);
pinMode(5, OUTPUT);

digitalWrite(2, LOW);
digitalWrite(3, LOW);
digitalWrite(4, LOW);
digitalWrite(5, LOW);
}
```

This part of the code is to set the pin inputs for the components.

```
void loop()
{
if (level == 1)
generate_sequence();//generate a sequence;

if (digitalRead(A4) == LOW || level != 1) //If start button is
    pressed or you're winning
{
show_sequence();    //show the sequence
get_sequence();     //wait for your sequence
}
}
```

This part of the code is to start generating random sequence for level 1 and wait for the player to press the push buttons following the sequence

```
void show_sequence()
{
digitalWrite(2, LOW);
digitalWrite(3, LOW);
digitalWrite(4, LOW);
digitalWrite(5, LOW);
```

```
for (int i = 0; i < level; i++)
{
digitalWrite(sequence[i], HIGH);
delay(velocity);
digitalWrite(sequence[i], LOW);
delay(200);
}
}
```

This part of the code is for the LED's to go off after showing the sequence, to wait for the player to press the buttons for the sequence

```
void get_sequence()
{
int flag = 0; //this flag indicates if the sequence is correct

for (int i = 0; i < level; i++)
{
flag = 0;
while(flag == 0)
{
if (digitalRead(A0) == LOW)
{
digitalWrite(5, HIGH);
your_sequence[i] = 5;
flag = 1;
delay(200);
if (your_sequence[i] != sequence[i])
{
wrong_sequence();
return;
}
digitalWrite(5, LOW);
}
```

This part of the code is to check to entered sequence if its matching the generated sequence or not, if not it all the LED's will go off until the player push any button again to start.

```
if (digitalRead(A1) == LOW)
{
digitalWrite(4, HIGH);
your_sequence[i] = 4;
flag = 1;
delay(200);
if (your_sequence[i] != sequence[i])
{
wrong_sequence();
return;
}
digitalWrite(4, LOW);
}
```

This part of the code is to check to entered sequence if its matching the generated sequence or not, if not it all the LED's will go off until the player push any button again to start

```
if (digitalRead(A2) == LOW)
{
digitalWrite(3, HIGH);
your_sequence[i] = 3;
flag = 1;
delay(200);
if (your_sequence[i] != sequence[i])
{
wrong_sequence();
return;
}
digitalWrite(3, LOW);
}
```

```
if (digitalRead(A3) == LOW)
{
digitalWrite(2, HIGH);
your_sequence[i] = 2;
flag = 1;
delay(200);
if (your_sequence[i] != sequence[i])
{
wrong_sequence();
return;
}
digitalWrite(2, LOW);
}

}
}
right_sequence();
}

void generate_sequence()
{
randomSeed(millis()); //in this way is really random!!!

for (int i = 0; i < MAX_LEVEL; i++)
{
sequence[i] = random(2,6);
}
}
void wrong_sequence()
{
for (int i = 0; i < 3; i++)
{
digitalWrite(2, HIGH);
digitalWrite(3, HIGH);
digitalWrite(4, HIGH);
```

```
digitalWrite(5, HIGH);
delay(250);
digitalWrite(2, LOW);
digitalWrite(3, LOW);
digitalWrite(4, LOW);
digitalWrite(5, LOW);
delay(250);
}
```

This part of the code is to generate the random sequences and flash all the LED's in the beginning

```
level = 1;
velocity = 1000;
}

void right_sequence()
{
digitalWrite(2, LOW);
digitalWrite(3, LOW);
digitalWrite(4, LOW);
digitalWrite(5, LOW);
delay(250);

digitalWrite(2, HIGH);
digitalWrite(3, HIGH);
digitalWrite(4, HIGH);
digitalWrite(5, HIGH);
delay(500);
digitalWrite(2, LOW);
digitalWrite(3, LOW);
digitalWrite(4, LOW);
digitalWrite(5, LOW);
delay(500);

if (level < MAX_LEVEL);
level++;
```

```
  velocity -= 50; //increase difficulty

  }
```

This part of the code is the settings for level 1 , and to increase difficulty for each level the player reaches. In figure 3.4 presented educational game on Arduino Uno R3.

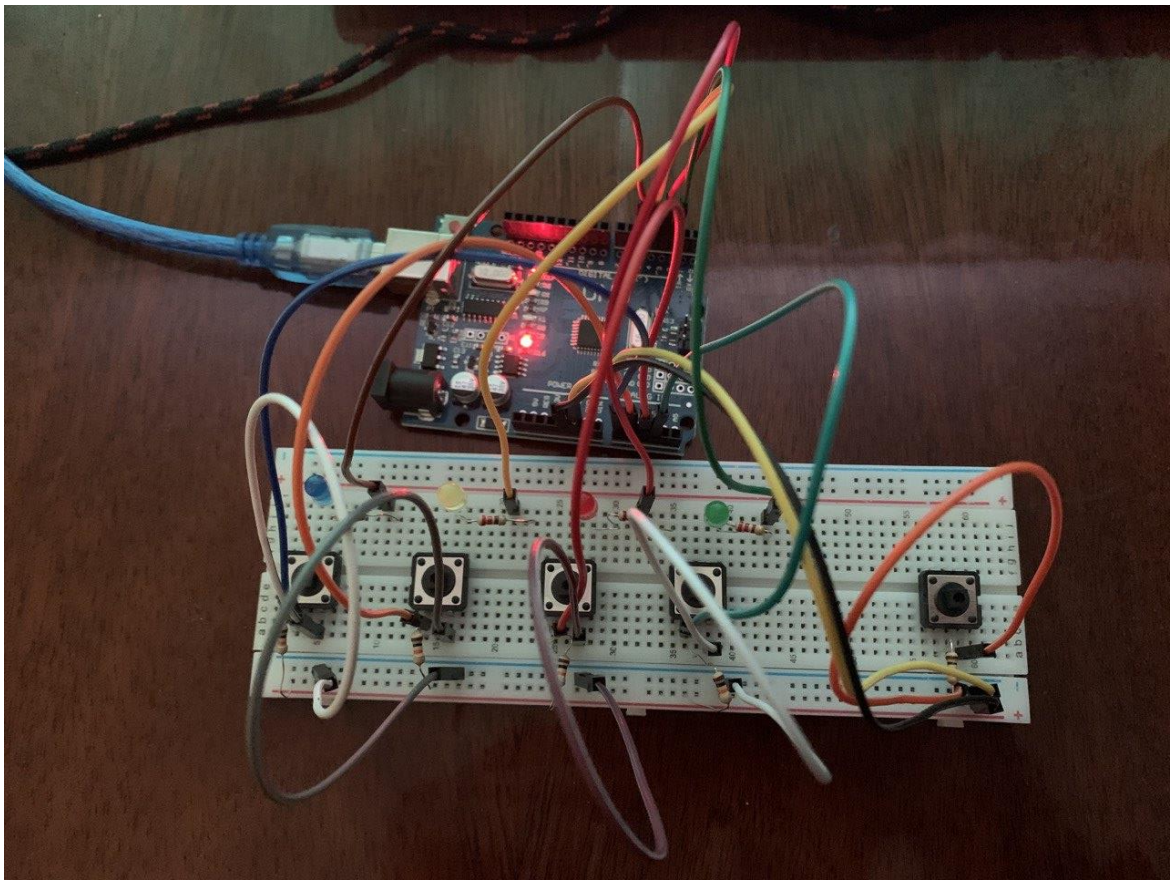

Fig 3.4 – Educational game on Arduino

The game start by flashing all lights and starting the rounds counter, then delay for one and a half second then starts the sequence that should be memorized by the player, every round start by light sequence to be repeated, turn on the LED for that array position and play the sound and delyas for 0.2 seconds between each LED flash, then start going through the sequence one at a time to check if the user presses the correct button, while counting time since round started, and check if the buttons that was pressed matches the sequence, if it didn't match then the timer stops and player

loses and playes losing tone and the loop breaks and turns all LEDs off so player can start over again, if it matched then delay for 0.5 seconds and start the new sequence for the next round and increase the round counter by 1

*Note; player will also lose if he passed the timier limit between pressing each button, and will go through the losing loop that was explained.

4 OCCUPATIONAL SAFETY AND HEALTH

The main components of a computer workstation are the desk or display suppor t, support for keyboard and mouse or other input device and the chair. A workstation should permit the user s to adopt a healthy, comfor table posture without overloading the musculo-skeletal system. To achieve this aim, the furniture should be adjustable as far as practicable. Other requirements include sufficient space on work surfaces for documents and sufficient leg room.

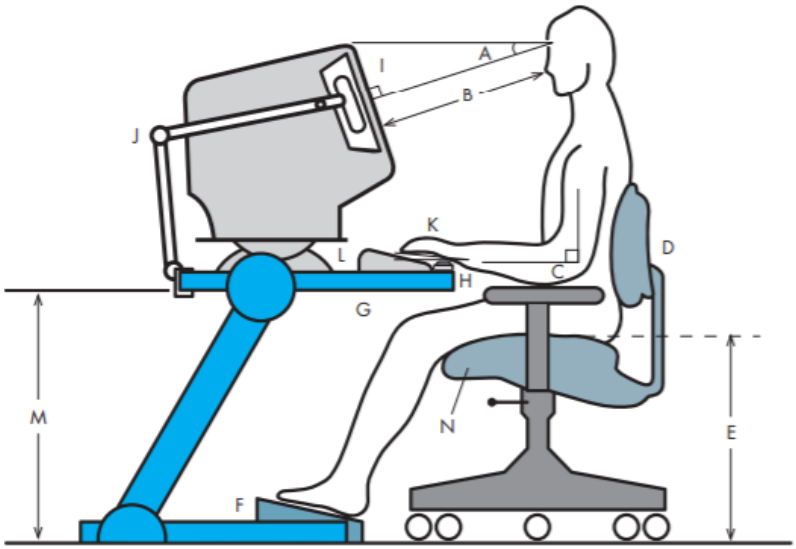

Fig 4.1 – Work space

(A) Comfor table viewing angle, e.g. 15˚ - 20˚

(B) Comfor table viewing distance, e.g. 350 - 600mm for text of normal font size

(C) Forearm and arm at about right angle

(D) Adjustable back rest

(E) Adjustable seat height

(F) Firm foot rest if required

(G) Adequate knee clearance

(H) Wrist rest if required

(I) Screen at right angle to line of sight

(J) Adjustable document holder

(K) Wrist kept straight or at most slightly inclined

(L) Screen suppor t adjustable for rotation and tilting

(M) Adjustable table height preferable

(N) Rounded or scrolled edge seat pad

Recommended computer workstation design and working posture displayed in the fig. 4.2.

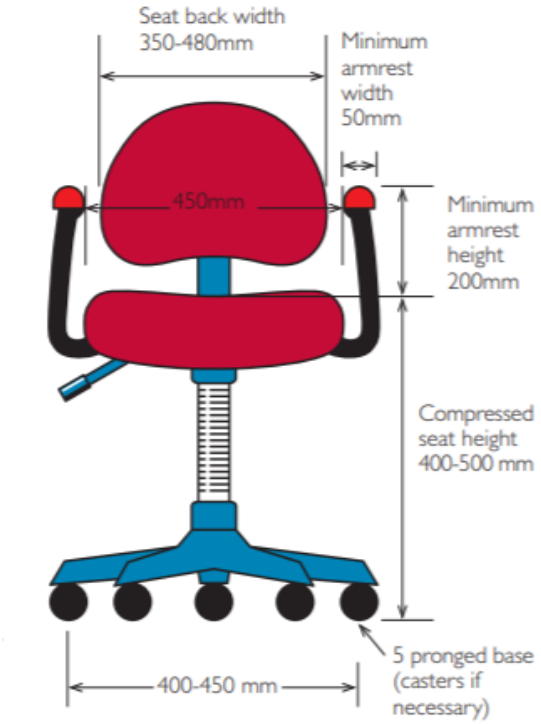

Fig. 4.2 – Requirements to chair

An office chair should have:

– a stable base (a five-pronged base is recommended) & smooth casters if necessary;

– adjustable seat height, from 400 to 500 millimeters;

– a slightly concave seatpan made with a dense foam and a breathable covering;

– swivel seat;

– round or "waterfall" front edge;

– adjustable backrest, both in height and tilt;

– a pair of armrest with adjustable height if necessary.

The monitor should be placed at a level where its topmost line of display is at about or just below the operator's eye level. The viewing distance between the operator's eyes and the screen should be around 350 to 600 millimeters for reading text of normal font size.

If frequent viewing of document for data entry is required, a document holder should be used. The document holder should be stable and adjustable for height, distance and angle of viewing. It can be used on either side of the monitor, thus minimizing the need for the operator to move the head to and fro and to refocus his eyes in order to read the screen and the document.

A footrest is recommended if an operator cannot rest his feet flatly on the floor even if the chair height has been properly adjusted. Small sized people usually need foot rest suppor t. The footrest should be stable, non-slippery, incline and height adjustable, and should not restrict leg movement.

If intensive keyboard operation has to be performed, a wrist rest may be used if the user finds it more comfor table. The primary function of a wrist rest is to keep the wrist straight during keyboard use and provide padding. When a proper wrist rest is used correctly, it can reduce the risk of repetitive strain injuries. However, while keying, remember to keep the hands above the keyboard and move the whole hand to reach side keys, rather than resting the wrist on the rest and bending the wrist sideways.

The wrists should only be resting on the wrist rest during pausing.

In selecting a wrist rest, the following criteria should be considered:

– thickness of the rest should be about the same as the front of the keyboard;

– the rest should be wide enough (front to back) to suppor t the wrist;

– wrist rests should not have sharp edges; and d. made of breathable materials

Equipment

Anti-glare screens improve screen visibility by reducing bright spots or washout caused by ambient light on monitor screens. Thus, these screens may be used to reduce screen reflections. Radiation emitted by a computer monitor is well below the limits set by international bodies for limiting health risks. It is therefore not necessary to add any filter to reduce the emission. In any case, the anti-glare screens are not designed for effective screening of radiation. Cur rently, there is no scientific evidence that prolonged computer work will cause permanent damage to the eyes or eyesight. However, prolonged use of computer can lead to eye strain. The best preventive measure to reduce eye strain is to view distant objects on a regular basis and do eye exercises.

Muscles of the neck may be sore if the phone receiver is cradled between the head and shoulder for a long time. When a computer and a telephone have to be used at the same time, it is recommended for the operator to use a headset.

The small size of the keyboard and the pointing device of a notebook computer lead to cramped postures of fingers and hands, thus causing early fatigue if the equipment is used for a prolonged period. It is recommended that a detachable keyboard and mouse be used if a notebook has to be used for long hours.

When operating a traditional keyboard, some computer users may have to bend their wrists to the side to type. This posture is unnatural and may strain the wrists. A V-shaped keyboard may help a user to position his hands naturally while keying in data. If a user is working well with a traditional keyboard, he/she may not need to change to this new type. If one wants to change to a new design, an evaluation should be made to ensure that the users can work comfor tably with the new keyboard.

Environment

One of the main causes of eye complaint made by a computer operator is glare. Glare can be reduced by:

- changing the position of any light sources causing the glare;
- fitting the light sources with appropriate diffusers or lampshade;
- providing cur tains or blinds to windows;
- ensuring that the screen is perpendicular to the light sources or windows;

– using anti-glare screen only if the glare cannot be effectively eliminated by other means.

Lighting levels ranging from 300 to 500 lux are appropriate for most computer desk work. Generally, the maximum lighting level should not exceed 750 lux. Excessive lighting levels have a "masking" effect and make it difficult for the operator to see the display on the screen (fig. 4.3).

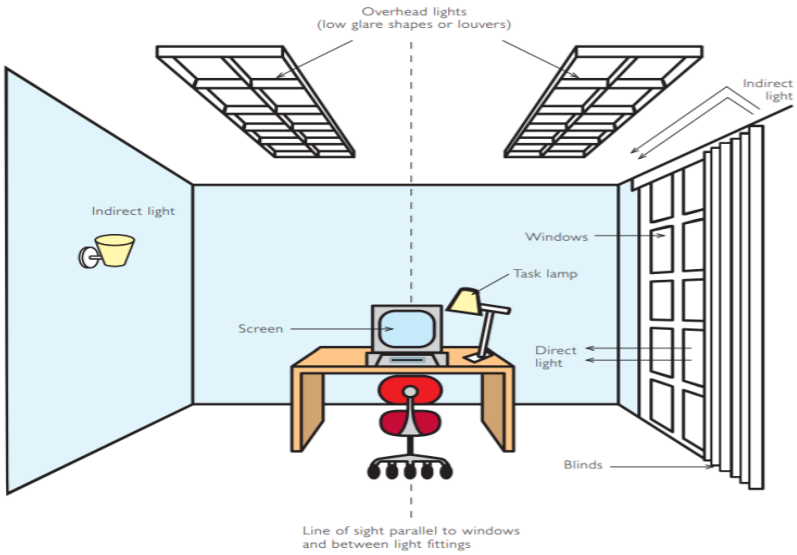

Fig 4.3 – Recommended lighting arrangement for a computer workstation

Working posture

If maintained for a prolonged period of time, improper working posture may result in pains and aches in the back, arms, neck and wrists. While operating a computer, an operator should adopt a natural and relaxed posture. Please refer to the diagram on page 3 for a recommended working posture. However, even if the posture is proper, keeping it for a long time is also stressful. Therefore, remember to change the posture frequently or have a task break, e.g. doing alternative work.

An operator should adopt the following practices in mousing (fig. 4.4):

– avoid squeezing the mouse or pressing the mouse buttons with excessive force;

– avoid bending the wrist sideways and/or forward; and

– perform mousing and the keyboard operation at the same height.

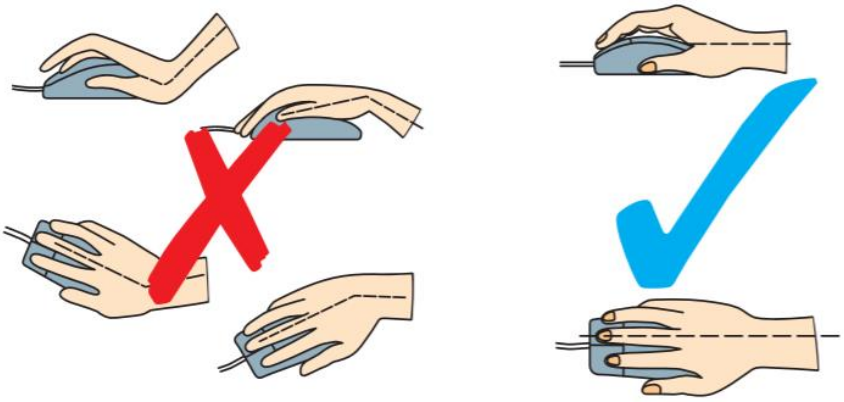

Fig 4.4 – Practice in mousing

Personal factors

Computer users may experience visual fatigue and discomfor t after prolonged computer work. Symptoms include burning eyes, blurred vision and headache . To alleviate eyestrain, a shor t task break (5 -15 minutes) taken after1-2 hours of continuous computer work is recommended. During the task break, the computer user should do alternative work, like filing, photocopying, etc., or get up, stretch and view distant objects. Proper eye glasses should be used to correct vision where necessary.

A computer user who wears bifocals tends to tilt the head back to view the monitor through the lower close-vision par t of the glasses. The top of the screen should be at 50 to 100 millimeters below eye level. If you still cannot work comfor tably with bifocals, you may need another type of spectacles, e.g. a pair of monofocal glasses.

The emission of radiation from a monitor is generally found to be substantially below the limits set by international bodies for limiting risk to human health. There is no conclusive scientific evidence to indicate any adverse health effect to the operator or the foetus.

Most people with epilepsy are completely unaffected by computer work. Even people suffering from the very rare photosensitive epilepsy, who are susceptible to flickering lights and strip patterns, also find computer work not affecting them in normal cases.

Exercises

During a break, you may follow the following recommended exercises to relax yourself. This can prevent early fatigue and musculo-skeletal disorders. You may repeat each exercise for several times. However, should you really have a health complaint, you should consult a physician (fig. 4.5-4.8).

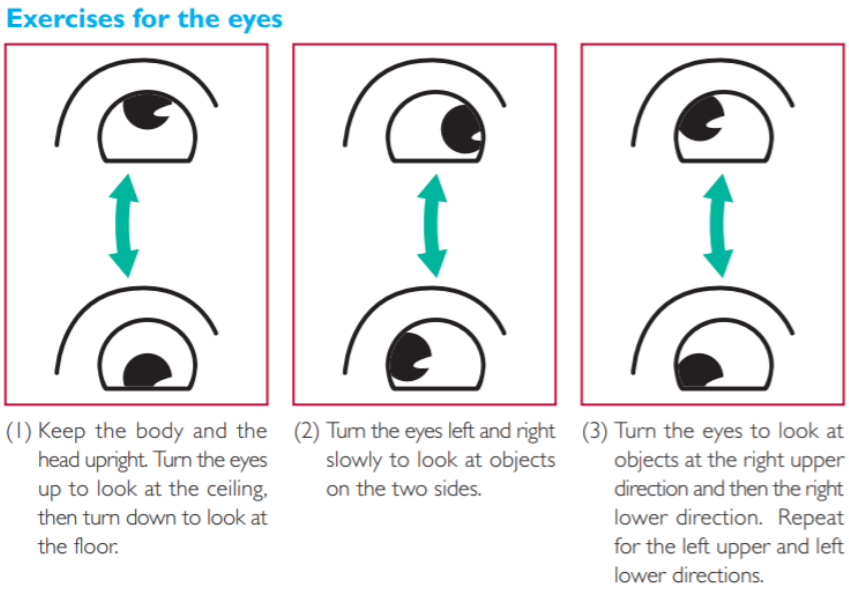

Fig 4.5 – Exercise for eyes

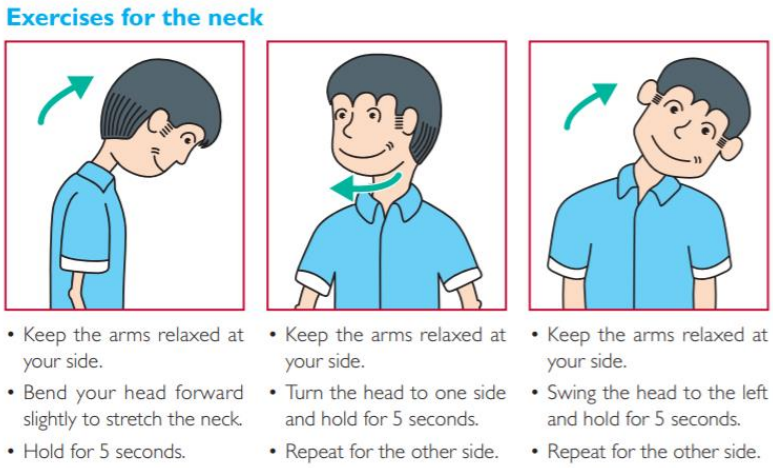

Fig 4.6 – Exercise for neck

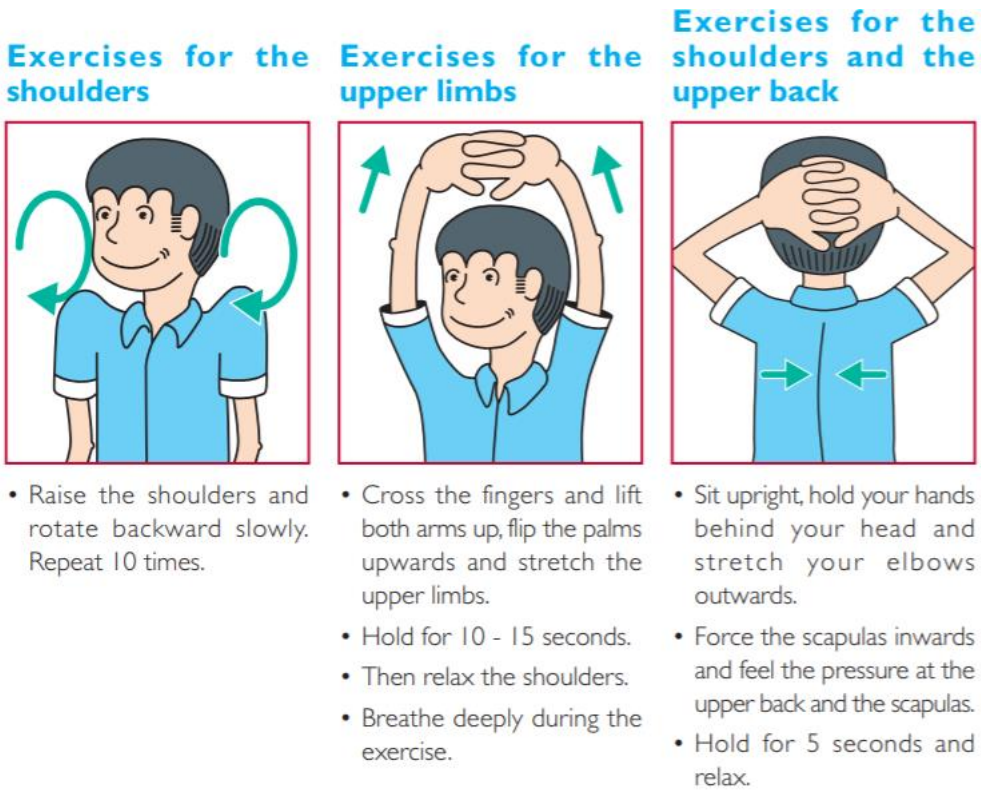

Fig 4.7 – Exercise for hands

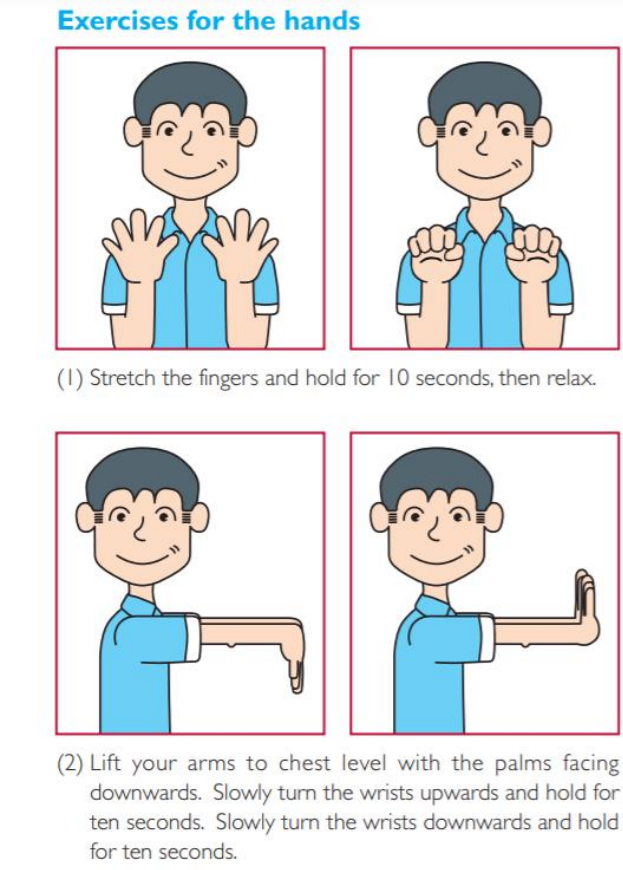

Fig 4.8 – Exercises for fingers

CONCLUSIONS

Now, we understand that the Arduino is the perfect tool for designing and introducing new products. We have studies on the functioning and operation of different types of Arduino microcontrollers. We also understand Arduino's hardware and software capabilities. For industrial use, the Arduino microcontroller is used to regulate the speed of motors. For robotic applications, the most appropriate.

We understand Arduino's operating theory, its capability in hardware/software, its implementations, where it is currently used and where it can be used in this article.

We also learned how to render Arduino's own IDE diagrams (software). It is endless to generate new concepts with Arduino, And we learned to design our own imagination to create and accomplish innovative stuff through this document. From interactive technology to space science the possibilities to use an Arduino to learn and build new ideas are limitless. It is a great instrument which can be used to learn, but it has its own disadvantages.

In this work I learned how to make a not only a simple game with simple components, it also have a physiological benefits for a person like me who forgets fast, using the famous in many projects and work the Arduino Uno R3 board, which makes it a suitable solution to people who have a short term- memory like me, and also financially possible for any person to get it due to its reasonable cheap price, and its simplicity to use and understand.

REFERENCES

1 Medea Arduino For Beginners/ Medea/ [Electronic Resource] Access mode: URL: http://medea.mah.se/2013/04/arduino-faq/

2 B_E_N What is an Arduino?/ B_E_N/ [Electronic Resource] Access mode: URL: https://learn.sparkfun.com/tutorials/what-is-an-arduino

3 Alan G. Smith Introduction to Arduino / Alan G. Smith / [Electronic Resource] Access mode: URL: https://web.archive.org/web/20180403132515/http://www.princeton.edu/~ffab/media___downloads_files/IntroArduinoBook.pdf

4 4 Hernando Barragán The Untold History of Arduino / Hernando Barragán / [Electronic Resource] Access mode: URL: https://arduinohistory.github.io/

5 Syed Tasnim Ahmed Arduino Project Report - Academic Project/ Syed Tasnim Ahmed / [Electronic Resource] Access mode: URL: https://www.researchgate.net/publication/342425973_Arduino_Project_Report_-_Academic_Project

6 Arduino Trivia PASTIBEN/ Arduino Trivia / [Electronic Resource] Access mode: URL: https://pastebin.com/Vt8RctM5

7 Jeremie PROECT HUB/ Jeremie / [Electronic Resource] Access mode: URL: https://create.arduino.cc/projecthub/Jerepondumie/make-an-arduino-memory-game-73f55e

8 CIRCUITO TEAM circuitio.ioblog/ CIRCUITO TEAM/ [Electronic Resource] Access mode: URL: https://www.circuito.io/blog/arduino-code/

9 Vasudhendra Badami hackereartth/ Vasudhendra Badami/ [Electronic Resource] Access mode: URL: https://www.hackerearth.com/blog/developers/arduino-programming-for-beginners/

10 Laura M. Bitdegree/ Laura M./ [Electronic Resource] Access mode: URL: https://www.bitdegree.org/tutorials/what-is-arduino-language-coding-for-arduino-boards-explained/

11 Brad Jones MUO/ Brad Jones / [Electronic Resource] Access mode: URL: https://www.makeuseof.com/tag/programming-languages-can-use-arduino/

12 Bhavana Harrilal Arduino programming language/ Bhavana Harrilal / [Electronic Resource] Access mode: URL: https://people.cs.uct.ac.za/~bharrilal/bhav/lit_review_HRRBHA001.pdf

13 Thomas Marco de Haan codementor/ Thomas Marco de Haan / [Electronic Resource] Access mode: URL: https://www.codementor.io/@dewetvanthomas/tutorial-arduino-programming-in-c-12b7cztyui

14 Gautam1807 Insttructablecircuits/ Gautam1807 / [Electronic Resource] Access mode: URL: https://www.instructables.com/Program-Arduino-Uno-in-C-Language/

15 Yahya Tawil All about circuits/ Yahya Tawil / [Electronic Resource] Access mode: URL: https://www.allaboutcircuits.com/technical-articles/understanding-arduino-uno-hardware-design/

16 Umair Hussaini technobyte/ Umair Hussaini / [Electronic Resource] Access mode: URL: https://technobyte.org/arduino-hardware-parts-explained-components/

17 Leo Louis Researchgate/ Leo Louis / [Electronic Resource] Access mode: URL: https://www.researchgate.net/publication/326316390_Working_Principle_of_Arduino_and_Using_it_as_a_Tool_for_Study_and_Research

18 DevicePlus Editorial Team DevicePlus/ DevicePlus Editorial Team / [Electronic Resource] Access mode: URL: https://www.deviceplus.com/arduino/arduino-the-popular-microcontroller-board-its-history-and-to-how-to-use-it/

Appendix A.

Technical Task

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
Ternopil Ivan Puluj National Technical University
Faculty of Computer Information Systems and Software Engineering

Computer Systems AndNetworks Department

“Approved”
Head of department
_____ Osukhivska H.M.
“___” _____2021

EDUCATIONAL GAME BASED ON ARDUINO CONTROLLER

TECHNICAL TASK

Degree Bachelor

“AGREED”	**“PERFOMER”**
Supervisor	Student of group ICI-43
_____ Phd.,Assoc. Prof. V.V. Yatsyshyn	_____ Sayed Ahmed M.
“____” _____ 2021	“____” _____ 2021

Ternopil 2021

1. Terms

This document describes tasks for development of educational game based on Arduino. Main objective of the diploma project is to build game for training children's memory. Project will be based on Arduino Uno R3 board.

1.1. Full name of system and its identification

Full name of the diploma project: «Educational game based On Arduino controller».

Identification: CSDP123.011.00.00

1.2. Order for system development

Order(№ 4/7-591, 31/08/2020).

1.3. Performer

Performer – student of ICI-43 group, department of computer systems and networks, Ternopil Ivan Puluj National Technical University, Sayed Ahmed M.

1.4. Inputdocumentsforsystemdevelopment

- specification of Arduino Uno R3;
- specification of lights;
- specification of buttons;
- specification of buzzer;
- specification of Arduino Uno R3 firmware;
- documentation of Arduino IDE.

1.5. The sequence of results presentation

Project consists the lists of documentation which response to the approved requirements of computer systems and networks department. Requirements response to the standards in the field of computer engineering development (ISO Standards).

Presentation of intermediate results of the diploma project is carried out according to the schedule approved by the supervisor.

1.6. Standards and regulatory documents

– Standard ANSI/EIA/TIA 568 - “Commercial Building Telecommunications Wiring Standard” and ANSI/EIA/TIA 569 - “CommercialBuilding Standard for Telecommunications Path wais and Spaces”.

2. Appliance and purpose of system design

2.1. Appliance of system

Arduino Uno is a device based on the ATmega328 microcontroller (data sheet). It includes everything needed to facilitate the operation of the microcontroller: 14 digital inputs/outputs (6 of which can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal resonator, a USB connector, and a power connection , A button for online programming (ICSP) and reset. To start using the device, you just need to power it from the AC/DC adapter or battery, or connect it to the computer via a USB cable.

ArduinoUno R3 from Arduino is currently one of the most popular microcontrollers. It has a huge online community with thousands of projects created. Whether you want to monitor the temperature and humidity outside the house, or let the Arduino control the robot to automatically balance itself, Arduino has a set of universal products that can be used in many DIY applications. Some of Arduino board advantages :

– Cheap: Arduino boards are relatively cheap compared to other microcontroller platforms.

– Cross-platform: Arduino software (IDE) runs on lots of operating systems like Windows, Macintosh OSX and Linux operating systems. Unlike most of the microcontroller systems they are limited to Windows.

– Simple and clear programming environment: Arduino software (IDE) is easy to use for beginners, but flexible enough that advanced users can also use it. For teachers, it is conveniently based on the processing programming environment, so students who learn to program in this environment will be familiar with how the Arduino (IDE) works.

– Open source and extensible software: Arduino software is released as an open source tool that can be extended by experienced programmers. The language can be extended through the C++ library, and people who want to know the technical details can transition from Arduino to the AVR C programming language based on this language. Similarly, you can directly add the AVR-C code to the Arduino program as needed.

2.2. Objective of system design

The objective is to create an memory training game with affordable budget, that helps the user to train his memory easily with simple method at anytime.

2.3. Characteristic of design object

Single-chipcontroller

3. System’srequirements

3.1. Requirementsingeneral

3.1.1. Requirements to the system structure and system operation

The structure of the hardware is based to be simple and basic to be carried easily, but system software must use the available hardware resources as efficiently as possible through the game logic and levels.

The functionality and flexibility of the system is ensured by the modification of the system software of the single-board computer and additional components.

3.1.2. Channels of system components communication

The consistency and the role of every component to be done , for each button to be connected with its LED and transferring the actions and getting the reactions through the system.

3.1.3. Requirements to the system diagnostic

In order to diagnose the system, it must be monitored using the appropriate tools included in the relevant system software. The tools should provide an easy interface for viewing diagnostic events and monitoring the program execution process.

3.1.4. Perspective of modernization

The system software can be modified to newer versions.

3.1.5. Requirements to the end users and their qualification

System administrators maintain the system in automatic or manual mode through management and monitoring. The minimum number of service personnel is one person.

3.1.6. Criteria of appliance

The system must be able to scale:

- by productivity;
- bycapcity of information process;

– Scaling capabilities must be provided by the basic software and hardware used.

3.1.7. Reliability requirements

The system must be operational and restored in the following situations:

– if the power system of the hardware operating system fails, causing a reboot;

– if a hardware operation error occurs (except for data carriers and programs), entrust the restoration of system functions to the OS;

– for errors related to software (operating system and device drivers). In order to protect the equipment against overvoltage and switching disturbances, use network filters and uninterruptible power supplies.

3.1.8. Safety requirements

The external elements of the technical measures of the system, which are under voltage, must have protection against accidental contact, and the technical measures themselves must have a zeroing or protective grounding GOST 12.1.030-81 and PUE. The power supply system must provide a protective switch during overloads and short circuits in the load circuits, as well as manual emergency shutdown. General fire safety requirements must comply with the standards for household electrical equipment. In the event of fire, no poisonous gases or vapors should be produced. After disconnecting the power supply, ensure that all fire extinguishers can be used. Harmful factors should not exceed the standards of SanPiN 2.2.2./2.4.1340-03 of 06/03/2003.

3.1.9. Requirements for operation, maintenance, repair and storage of system components

The microclimate in rooms with the corresponding hardware has to correspond to norms of an industrial microclimate on (GOST 12.1.005-88).

For normal operation of the network it is necessary to support (according to GOST 23.865-85):

– air temperature in the range from + 15C to + 20C;

– relative humidity at 20C in the range from 30% to 70%;

– atmospheric pressure 760mm Hg.

The technical means used must be regularly maintained according to the requirements of the technical documents, but not less than once a year. Regular maintenance and testing of technical means should include maintenance and testing of all used means, including workstations, servers, cable systems and network equipment, and uninterrupted power supplies. According to the test results of technical means, the reasons for the defects should be analyzed and eliminated. The location of the premises and its equipment must prevent uncontrolled entry by outsiders and ensure the security of confidential documents located in these premises and technical means.

3.1.10. Requirements to standardization and unification

Compatible with common computer interfaces.

3.2. Requirements for types of collateral

3.2.1. Requirements to the system’s hardware (technical characteristics of each devices in the system)

1. Single-board computer with low power consumption and the ability to control hardware.

2. USB cable for PC connection

3. Push tact buttons to select each LED

4. LED to light in certain order for the game

5. Prototyping board to connect the components

6. 220 Ohm resistors for the LED to light

3.2.2. Structure and contest of design system

The composition and content of system design work includes: (translate)

– design and coordination of the technical task for the system;

– system design;
– writing an explanatory note;
– design of graphic material;
– defense of the qualifyingpaper.

4. Technical and economic indicators

The cost of development should not exceed 450 UAH.

The service life of the device must be at least 18,000 thousand hours. (2 years)

* Note: the cost of development may change during the calculation during development.

5. Stages of system design

Table 1 - Stages of system design

Numberof stage	Stage	Duration
1	Development and approval of the technical task	16.03-20.04.2020
2	Analysis of the technical task	21.04-21.04.2020
3	Substantiation of possible technical solutions	24.04-30.04.2020
4	System design and implementation	01.05-17.05.2020
5	Testing of the designed system	19.05-24.05.2020
7	Section of labor protection and safety in emergency situations	10.05-17.05.2020
9	Registration of the qualifiying paper	18.05-27.05.2020
10	Preliminary defense of the qualifiying paper	13 червня 2020
11	Defense of the qualifiying paper	13 червня 2020

6. The order of control and acceptance

The control of the process of execution of the diploma project is carried out by the head of the diploma project.

Normocontrol of the diploma project for compliance with the requirements of the standards is carried out at the Department of Computer Systems and Networks.

The presentation of the results of the diploma project is done by defending the diploma project at the relevant meeting of the SEC, illustrating the main achievements through the graphic material.

7. Requirements for documentation

The documentation must meet the requirements of ESKD and DSTU

Set of design documentation:

– explanatory note;
– applications;
– graphic material:

a) wiring diagrams of the device board through specialized interfaces;

b) block diagram of the device components;

c) algorithms of the created software;

d) block diagram of the device software;

e) the deployment scheme of this solution.

* Note: The design documentation may be subject to change and addition during development.

8. Additional conditions

During the implementation of the thesis project, changes and additions may be made to this technical task.