INFRARED MONITORING AND SUPERVISION SYSTEM

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ABSTRACT: The paper presents the design and implementation of an infrared monitoring and supervision system, which can be used in various companies, institutions, enterprises for the protection of goods and people. For the safety of personnel and goods, this system can be optimally located, thus ensuring the avoidance of accidents and various destructions. The system being capable of detecting movement, it warns both audibly and visually. This system was achievable thanks to components such as a development module, the software programming of this module, the infrared sensor, visual LED signaling, but also acoustics through a piezoelectric speaker. The developed, physically realized and tested system is a current one with a relatively simple implementation. At the same time, it ensures effective protection for various applications that require increased supervision.

KEY WORDS: system, Tinkercad, Arduino, software, monitoring, supervision

1. INTRODUCTION

Infrared monitoring and supervision of objects are important technologies used in various fields such as automation, detection, security, industrial control and in domestic use.
Infrared technology, abbreviated as IR, works by emitting invisible infrared electromagnetic radiation, which is detected by certain sensors.

2. DESIGNING OF THE INFRARED MONITORING AND SUPERVISION SYSTEM IN TINKERCAD

The Arduino UNO R3 [4] consists of a microcontroller, along with many other components to help users create and debug projects. It comes with a USB Type A to USB Type B power cable. Its layout in Tinkercad [1] is shown in Figure 1.

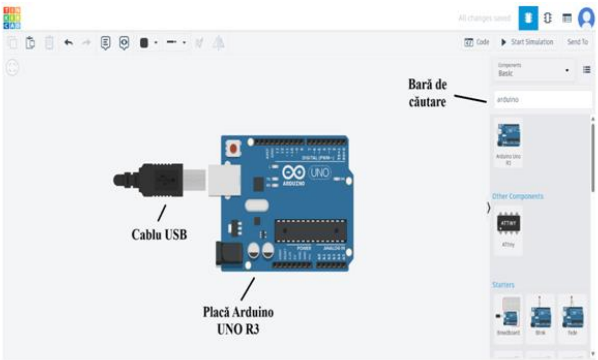

Figure 1. Arduino UNO R3 board placement

A 400-pin BreadBoard (Figure 2) was used to place all the components.

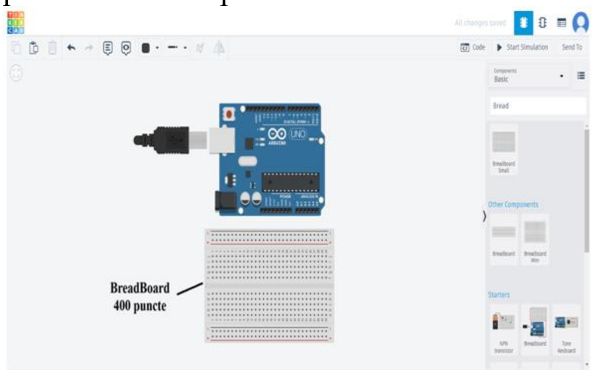

Figure 2. BreadBoard placement

A safety part is the piezoelectric buzzer (Figure 3) which is placed on the BreadBoard.

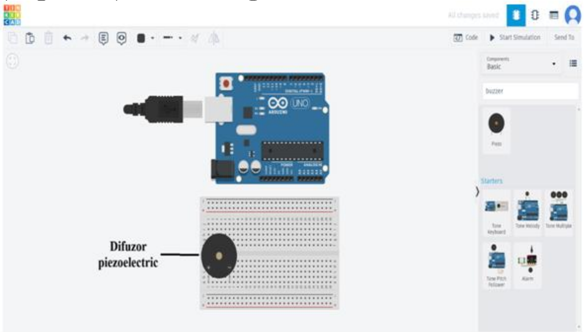

Figure 3. Piezoelectric buzzer on BreadBoard

The connections are made using Dupont wires (Figure 4).

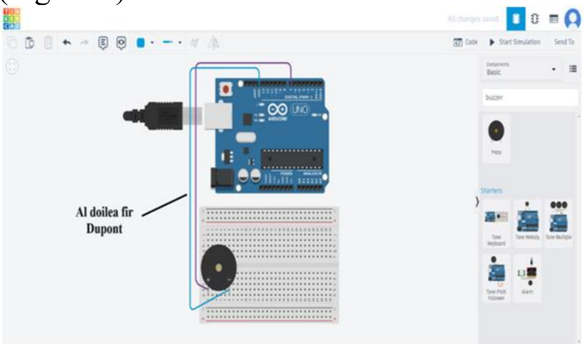

Figure 4. Tracing the negative wire from the piezoelectric buzzer to the Arduino UNO R3 board

The next step in the system's operation is to place a red LED (Figure 5). This LED is accompanied by a resistor that restricts the current flow.

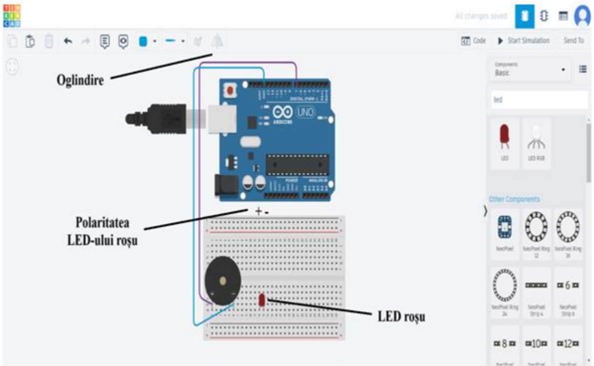

Figure 5. Red LED placement and polarity representation.

One of the most important parts of this monitoring and supervision system is the infrared sensor.

The infrared sensor, like any other component, needs to be powered by a voltage source.

It is powered by tracing the last cable from the last terminal of the component to the positive portion of the BreadBoard (Figure 6).

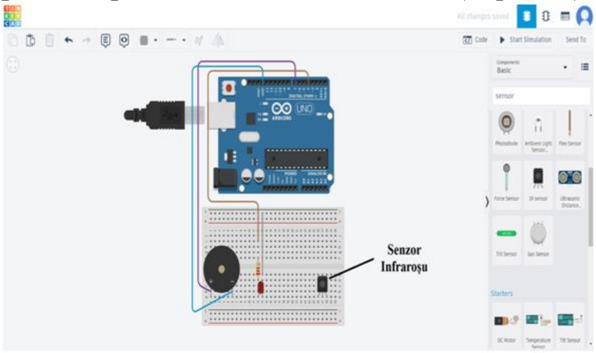

Figure 6. Placing the IR sensor on the BreadBoard

The infrared sensor, like any other component, needs to be powered by a voltage source.

It is powered by tracing the last cable, from the last terminal of the component to the positive portion of the work plate (Figure 7).

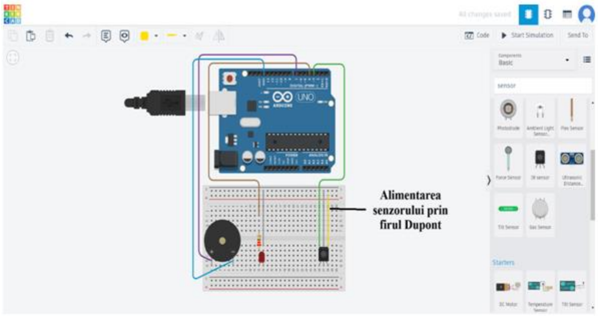

Figure 7. Powering the sensor through the Dupont wire.

A final component of this system is the infrared sensor remote control. This is added to the system because the sensor cannot function as in reality because a simulation must be performed in Tinkercad [6]. In reality, the sensor is based on infrared waves that capture any object.

The remote control or "remote" (Figure 8) of this infrared sensor sensor is used as an action element of the sensor, equivalent to passing an object in front of the sensor.

In the practical implementation of this system, the remote control is not found due to the difference in the Tinkercad simulator component, compared to the physical part.

The operation of the developed system is based on a very important aspect, its coding.
Using the C++ language, Tinkercad also offers the possibility of using a code editor. The code was developed so that any user can read it without problems.
The simulation of this system is done by pressing the "Start Simulation" button within the application interface (Figure 8.).

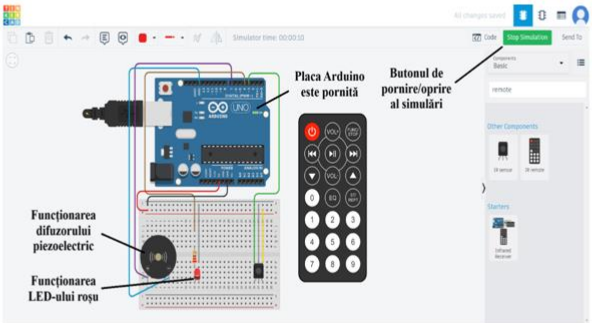

Figure 8. System simulation in Tinkercad application

Once this button is pressed, the Arduino UNO R3 board is powered at a voltage of 5V and is ready to respond to any command it will receive.
Virtually, the infrared sensor is activated through its remote control. One of the remote control buttons is pressed, and the sensor receives the response, the system acting further, lighting the red LED and turning on the piezoelectric buzzer that emits a sound. These work as long as the remote control button is pressed.
To stop the system, click the "Stop Simulation" button, colored green this time.

3. REALIZATION OF THE INFRARED MONITORING AND SUPERVISION SYSTEM

The steps that must be followed to integrate the hardware components, as well as verify their functionality [2], depend largely on the structure of the assembly simulated in the Tinkercad application.
The first main component of this system is the Arduino UNO R3 [5] (Figure 9.).

Figure 9. Arduino UNO R3 board

The next component added to the development board is the 400-pin BreadBoard, which is used to interconnect the system elements, making it possible to operate. [10]
The piezoelectric buzzer (Figure 10), used in this system, is placed on one side of the BreadBoard to streamline the work space on this board.
It can be described as a small component that when it receives electricity, vibrates, displacing air and thus creating sound waves. [9]

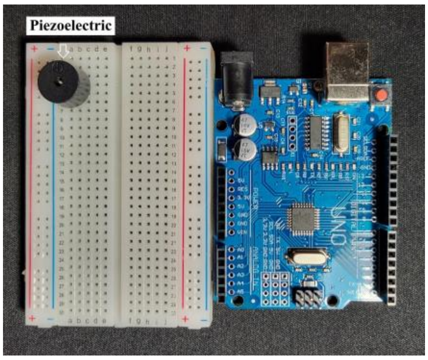

Figure 10. Piezoelectric buzzer placement on BreadBoard

The next step in building the system is to place the red LED [3] on the BreadBoard (Figure 11), serving as a warning light.

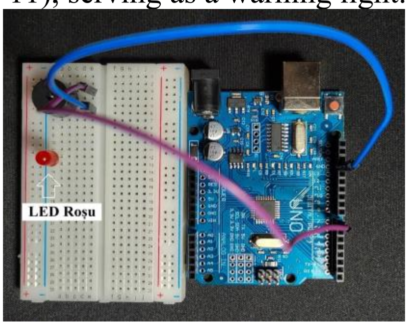

Figure 11. Layout of the visual warning LED on the BreadBoard

In the simulation part of the system, the infrared sensor was used together with the

remote control that operated it, being the only way in which the sensor worked correctly.
This remote control is not used in the case of the physical component because the infrared sensor acts upon encountering any obstacle.
Thus, the infrared sensor [7] was placed in the last connection points of the BreadBoard so as not to interfere with the other components or wires of the system when it is operated (figure 12).
The 2 LEDs at the top of the sensor have the task of monitoring any movement or object over a distance between 2 cm and 10 cm, which can be adjusted. For example, if one of the system wires is above the sensor, it can operate indefinitely.

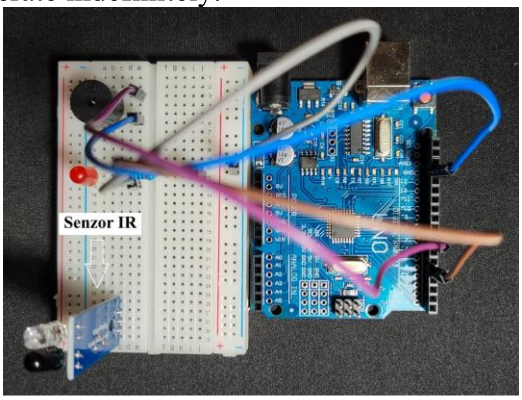

Figure 12. Placing the infrared sensor on the BreadBoard.

Finally, the physically realized infrared monitoring and supervision system is shown in figure 13.

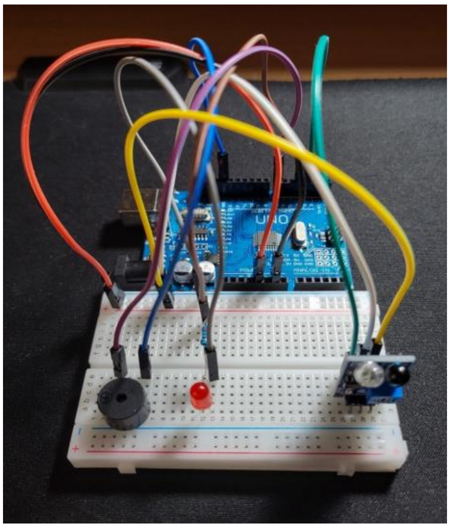

Figure 13. Infrared monitoring and supervision system implemented

4. TESTING THE INFRARED MONITORING AND SUPER-VISION SYSTEM

In the simulation of this system, the Arduino UNO R3 board was powered at a voltage of 5V [8].
In this case, this voltage comes from the USB 2.0 port of the laptop, by connecting the cable that comes with this development module. (Figure 14.).

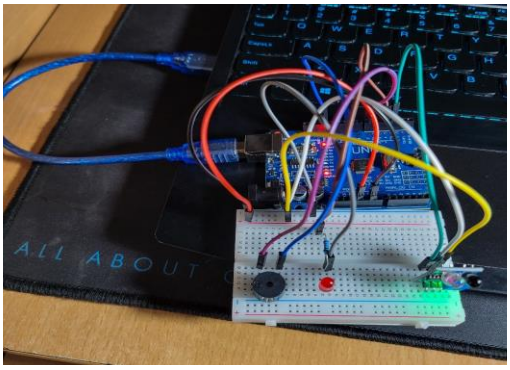

Figure 14. Powering the entire assembly at the 5V voltage of the laptop.

As can be seen in the image, the LED corresponding to the inscription "ON" on the Arduino UNO R3 board is lit, indicating the operation of this module.
Also, the green light-emitting diode on the infrared sensor is lit, suggesting the functionality of the component.
After these organizational aspects, the system is tested for three obstacle cases.
The first obstacle case is the passage of a metal object, in this case, a screwdriver, in front of the infrared sensor (Figure 15).

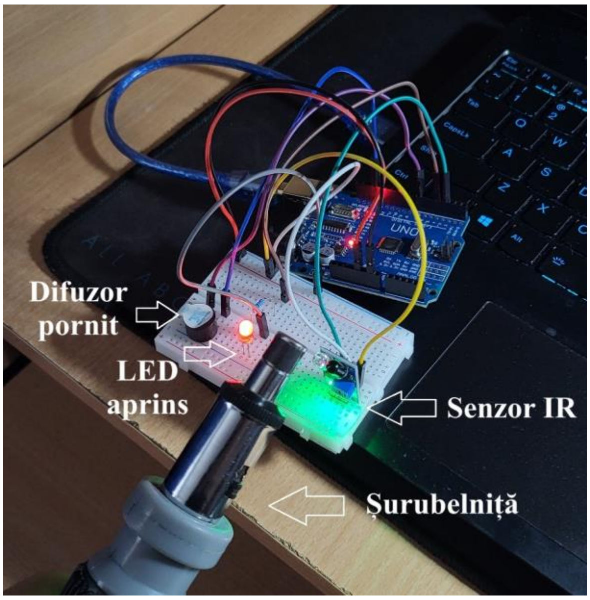

Figure 15. Passing the screwdriver in front of the infrared sensor

If the object is within the detection range of the sensor, the piezoelectric buzzer is activated, emitting a continuous sound signal, and the red LED remains lit.
These two alert components stop working when the object disappears from the front of the infrared sensor (Figure 16).

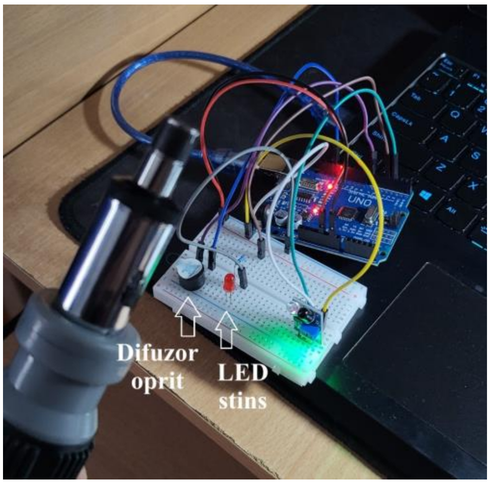

Figure 16. Removing the screwdriver from the front of the infrared sensor

The second case of an obstacle is the passage of a non-metallic object, such as a plastic piece, in front of the infrared sensor (Figure 17).

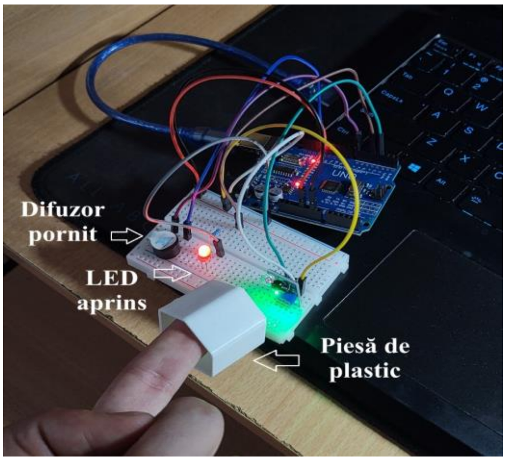

Figure 17. Passing the plastic part in front of the infrared sensor

The removal of this plastic piece from the system's supervision range is shown in Figure 18.

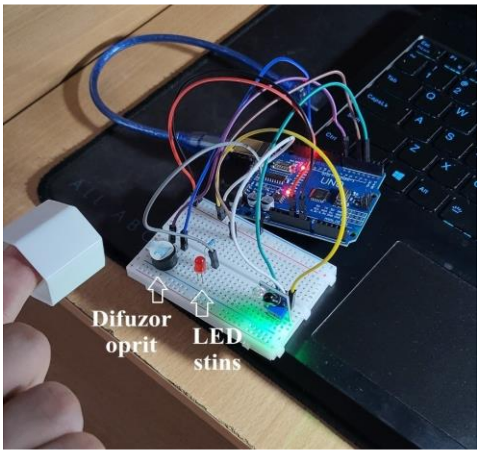

Figure 18. Removing the plastic part from the system's supervision range

The third case of obstacle is using the hand to operate the infrared monitoring and supervision system (Figure 19).

Figure 19. Passing the hand in front of the infrared sensor

To stop the operation of the piezoelectric buzzer and the LED, remove your hand from the infrared sensor range (Figure 20).

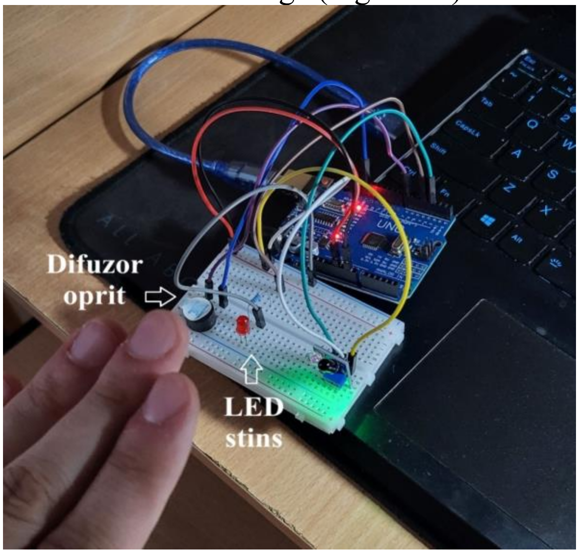

Figure 20. Removing the hand from the infrared sensor

5. CONCLUSION

Based on the development and simulation of the system in the Tinkercad application, the physical components that are part of the system were presented as well as their assembly and the source code to obtain the physical functionality of the infrared monitoring and supervision system.

Following the tests carried out, it is observed that the system works correctly because it detects various obstacles for both metallic and non-metallic parts, warning the user optically and audibly.

The developed infrared monitoring and supervision system can be used in various companies, institutions, enterprises for the protection of goods and people, respectively it can also be used in an enterprise where massive parts are transported using a crane. For the safety of personnel this system can be placed in front of the crane, thus ensuring the avoidance of accidents through detection and audible and visual warning. This system was possible thanks to components such as a development module, software programming of this module, infrared sensor, visual LED signaling, but also acoustic through a piezoelectric speaker.

The developed, physically realized and tested system is a current one with a simple implementation. At the same time it ensures effective protection for various applications that require increased surveillance.

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