Journal of Engineering Research and Applied Science
Available at www.journaleras.com
Volume 12 (2), December 2023, pp 2395-2400
ISSN 2147-3471 © 2023

Smart Hygienic Sunbed

Yaşar Şen

Duzce University, Biomedical Engineering, Duzce, Turkey

Accepted 23 December 2023

Abstract
Known as a "sun lounger" in the tourism industry, it is a mobile, adjustable single bed for sunbathing and relaxing. Non-contact cleaning of sunbeds forms the basis of disinfection. In this study, the design of the sunbed disinfection system and the installation and application processes of the Arduino controlled spray nozzle system were recorded. In order to make the hygiene conditions that have entered our lives more acceptable, the study aims to make the sun beds that are available to many people during the day more sterile in terms of use.

Keywords: *Sunbad, pandemic, arduino, disinfection, hygien*

1. Introduction

As it is known, Covid-19, which appeared in China at the end of 2019, has become a rapidly spreading disease due to its high transmission rate. Countries have taken very drastic measures to prevent the spread of the disease, and the economy and social life have come to a standstill [1]. On this day, with the normalization of the tourism sector, a sunbed with a beach or other areas of use becomes of special importance. Sunbeds in the common areas of beaches, which are an object used by many people during the day, carry the risk of harboring the virus on their surfaces. In this study, it is aimed to eliminate or reduce the effectiveness of diseases that can be transmitted through contact with viruses and such surfaces. We designed the sunbed about half the size of a normal December sunbed and placed 6 spray heads on it at appropriate intervals. During the spraying phase, the contact surfaces of the sunbed were disinfected.

Similar projects within the scope of the project we have designed in the literature include cooling and nozzle systems for plant irrigation Decking. At the same time, an application that provides automatic disinfection of sunbeds has not yet been found in the literature.

2. Material and Method

One of the most important components of the disinfection system is the liquid transfer pump and spray nozzles.

The heat pumps produced in the world are no better than the characteristics of the Carnot cycle, and all practical cycles are as close as possible to this characteristic. [1]

COPh in pumps depends on several factors. The temperature difference between the condensation and evaporation temperature basically determines the efficiency: the smaller the difference, the higher the COPh.[1]

In spray nozzle systems, pressurized mains water or a liquid engine that will provide the necessary pressure to the spraying process are commonly used. In this project, a liquid transfer pump working with DC 12V was preferred. The reason for this is that the pump will be able to spray to the desired distance even in adverse weather conditions by providing sufficient pressure in the spraying process.For this reason, Kemos brand liquid transfer pump, which is smaller in size and simple to use, can operate at lower power, instead of more noisy and costly equipment such as compressors. The pump has a power of 30W and has the capacity to transfer 15 liters of liquid per minute. The dimensions of the pump used in the device are 16x4.4 mm. (Figure 1).

Corresponding author: yasarsen@duzce.edu.tr

Figure 1. Photograph of the pump

In the study, Arduino Uno, an expandable board with electronic hardware and software, was used to control the liquid transfer pump. Since the Arduino Uno model can provide 5V output, the 12V power needed by the liquid transfer pump was provided by using a 19V adapter with the help of the relay board. IR ultraviolet light sensor was preferred in order for the system to work without contact. The signal received from the IR sensor is transferred to the Arduino uno and the signal is transmitted to the Arduino's signal pin connected to the relay for 10000 microseconds, so that the relay works for 10 seconds and power is transferred from the power source to the liquid transfer pump. After the pump has been running for 10 seconds, the Arduino will detect the IR sensor. It cuts off the incoming signal for 3.6 seconds and puts itself on hold, thus preventing the pump from operating unintentionally. The emitting tube emits light at a certain frequency in the infrared band. When an obstacle passes through the beam, the light reflected on the surface of the obstacle is read by the receiving sensor. In this way, a digital signal is sent to the arduino. The working distance of the module is between 2-30cm and the detection angle is 35°.

2.1 Disinfected Sunbad Design and Manufacture

Pro Engineer computer aided design program was used to design the Disinfected Sunbad. The prototype we created was half the size of a regular chaise longue. In this way, it will be easier to place the necessary materials on the sun lounger. This design was created in the carpentry shop. We have determined 6 points to create a disinfectant system on the sunbed and to add the spray nozzles. 6 points were determined to create a disinfectant system on the lounger and to add the spray nozzles. Holes were drilled at these points and nozzles were placed at these points.

Disinfected Sunbad as shown in figure 2, 3:

Figure 2. Disinfected Sunbed sample

Figure 3. Disinfected Sunbed sample

As seen in Figure 3, As can be seen in Figure 3, the nozzle and hose connections are placed under the sun lounger and fixed in place with silicone. The nozzle hose is connected to the 12V liquid pump with the part in Figure 4.

Figure 4. The 12 V liquid pump with the part

With the connection of the circuit controlling the pump, the Disinfected Sunbed system is completed. The circuit control part consists of Arduino Uno, 5V relay board, and 9V battery. The collective image of the elements used in the circuit is shown in Figure 5.

Figure 5. The collective image of the elements in the circuit

In addition, the switch added to the circuit connection prevents the circuit from starting automatically.

2.1.1 Circuit Elements

Wooden Chaise Longue: It is the bed part, which is the stretching part in the project. Spray nozzles are attached to this part.

Spray Nozzle: The nozzle is a tubular or tubular element of a varying cross-section. They are used to direct the flow of a fluid or change its velocity. Nozzles are often used to control the amount, direction, flow rate, velocity, and shape of flow in various systems. There are many types of nozzles according to the place and system used.[2]

IR sensor: In order for the system to work without contact, the IR ultraviolet light sensor is used, the signal received from the IR sensor is transferred to the Arduino UNO and the signal is transmitted to the Arduino's signal pin connected to the relay for 10000 microseconds. In this way, the relay operates for 10 seconds, and power is transferred from the power source to the liquid transfer pump.

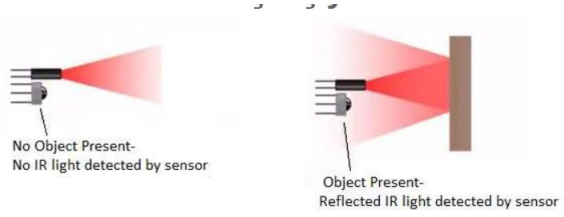

Figure 6. IR light sensor situations [3]

19.5V AC Adapter: It is the adapter that provides the energy required for the liquid transfer pump in the project. It has 100-240V 60Hz input, 120W 19.5V 6.15A output values.

1 Channel 5V Relay Board: Since the Arduino UNO model can provide 5V output, the 12V power needed by the liquid transfer pump was provided by using a 19V adapter with the help of the relay board. Working range; It can control current up to 10 amps at 30V DC or 220V AC voltage.

Liquid Transfer Pump: Pressurized mains water or a spray liquid engine are commonly used in spray nozzle systems. DC 12V liquid transfer pump was preferred in this project. The reason for this is that the pump will be able to spray to the desired distance even in adverse weather conditions by providing sufficient pressure in the spraying process. The pump has a power of 30W and has a liquid transfer capacity of 15 liters per minute.

Screws and Cables: It is used to connect circuit elements in disinfected sun loungers.

Arduino Uno R3: Arduino is an open-source platform used for the easy creation and programming of electronic circuits. Arduino UNO can interact with many devices, including the internet environment. It can send commands to output devices such as DC motor, LCD screen, speaker.[4]

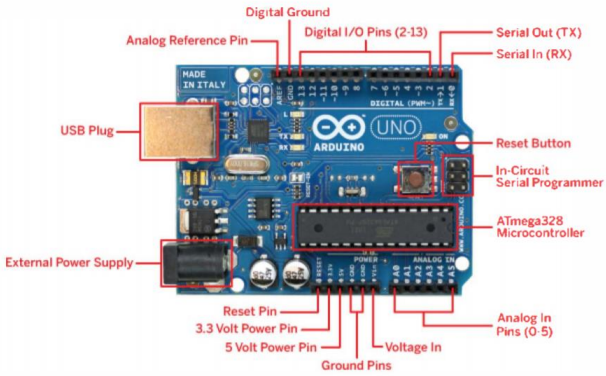

Figure 7. Photograph of Arduino Uno R3 [3]

Arduino boards consist of side elements that require connection with other circuits, especially the Atmel AVR microcontroller, for the programming of the board. Each of the boards has at least one 5V regulated IC. A 16 MHz crystal oscillator is one of the card's essential requirements. A bootloader program is preloaded on the board's Microcontroller. Therefore, it does not need an external programmer like the initial setup.[5]

Table 1. Arduino UNO R3 specifications

Microcontroller	**ATmega2560**
Working Voltage	5V
Supply Voltage (Recommended)	7-12V
Suply Voltage (Limit)	6-20V
Dijital I/O Pins	14 (6 pin PWM output)
Analog Input Pins	6
Current of I/O Pins	20 mA
3.3V Pin Current	50 mA
Flash Drive	32 KB (0.5 KB used by bootloader)
SRAM	2 KB
EEPROM	1 KB
Clock Frequency	16 MHz

2.2 What is Disinfection?

Disinfection is a word originating from French, and it is a process that kills harmful microorganisms in an inanimate environment or prevents them from multiplying. The chemicals used for this process are called disinfectants. Despite these lethal effects, the effects of disinfectants are limited. Because organisms that carry harmful viruses and microorganisms are effective in the spread of diseases. The effect of disinfection is direct and has a limiting effect on large contaminations [6].

The use of disinfection in the health field is during or after the disease. It is done to prevent the spread of the disease. Disinfectants can be divided into three groups according to their degree of effectiveness [6].

Ultimate Disinfection;
These are the necessary processes for 3-hour sterilization with chemicals. These processes take between 10 and 20 minutes. It kills all microorganisms except bacterial spores, which are very resistant.

Intermediate Disinfection
They are disinfectants that are effective against viruses, microbacteria and microorganisms, but not against bacterial spores.

Low-Level Disinfection
Bacterial spores are disinfectants that are ineffective against germs, bacteria, and viruses but kill some microorganisms.

2.3 What is the impact of COVID-19 and the virus on the tourism industry?

The new type of coronavirus is a virus that first affected the upper respiratory tract with symptoms of fever, cough, and shortness of breath in the city of Wuhan, Hubei Province of China, in late 2019. It was seen that the Covid-19 virus, which could only be identified at the beginning of 2020, multiplied from the seafood and animal market in the city of Wuhan, was effective first in China, then in Europe and America, and turned into an epidemic [7].

This process had a very negative impact on the world economy. In particular, tourism enterprises have brought their work to a partial or complete halt. According to the 2019 data of the Ministry of Culture and Tourism, a total of 51.7 million people, both domestic and foreign, came to our country. When these figures are compared with 2018, it is seen that there is an increase of 12.1%. Such a high number of people is quite enough to understand how important tourism is for our country.

However, due to the successive bans due to the Covid-19 epidemic, the decrease in people's desire to travel, fears, and concerns, tourism revenues have decreased considerably in our country, as in all countries. However, in order to reduce this effect on tourism, many measures are taken on the basis of both businesses and the state [8].

Figure 8: Impact of COVID-19 on Tourism

The first evaluations about tourism started with the restrictions on the flights of airline companies. As a result of the virus that emerged in China and turned into a pandemic, flights between China and Turkey were stopped for the first time. Apart from this, a 14-day quarantine has started for those coming from

abroad. Today, normalization efforts continue, and improving hygiene conditions is a very important issue.

2.4. Disinfection Sunbad Circuit

Connections and Software

The connections of the disinfected lounger circuit are made with wires soldered to each other and jumper wires.

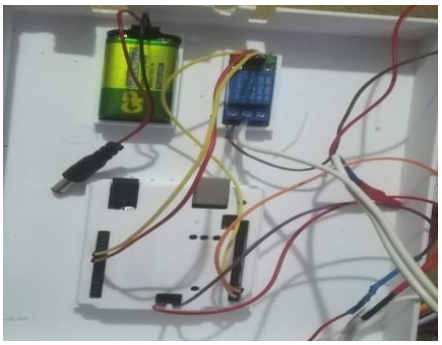

Figure 9. The connections of disinfected lounger circuit

The flow chart is used to more easily explain the connections of electronic components in the circuit.

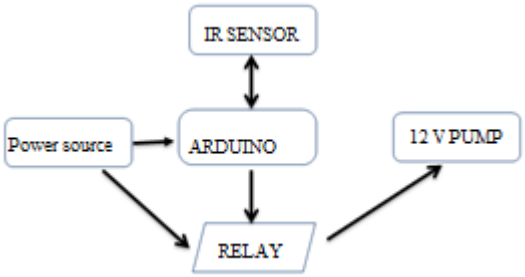

Figure 10: Flow chart of the system

The circuits previously used with the IR sensor have been researched and adapted to the part we need in the circuit. Since the circuit is not complicated, Arduino UNO was sufficient in this study. The Arduino will operate the relay with the signal from the IR sensor. In this way, the liquid pump will work as long as the contacts of the relay are open.

Figure 11. Liquid coming out of the nozzles

The pressurized disinfectant liquid sent by the liquid pump passes through the hoses and reaches the nozzles, which is the exit point where the spraying is made. The disinfectant liquid coming out of the nozzles is shown in Figure 10.

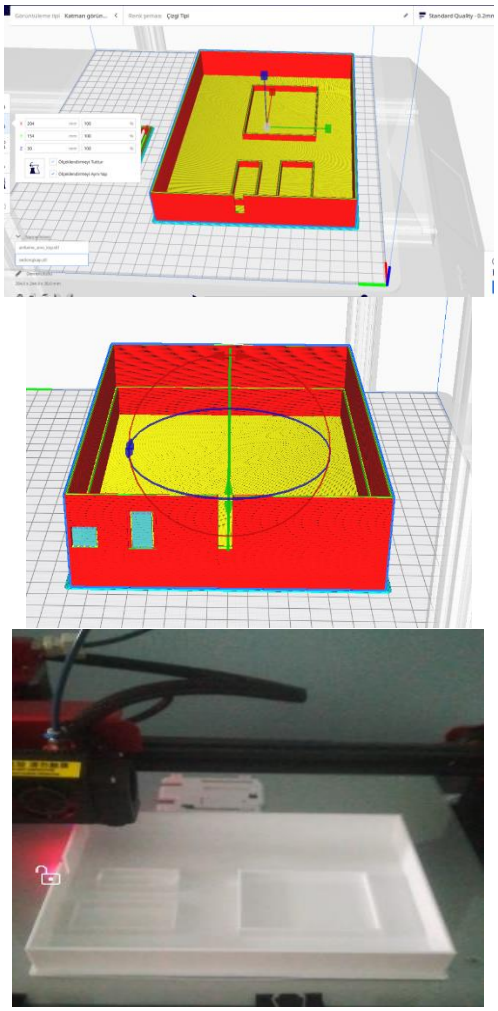

Figure 12. Cad design of the circuit control unit

2.5. Producing the Control Unit of the Device using a 3D printer

A CAD program was used to produce the parts we call the circuit control unit, which is one of the external parts of the device, on a 3D printer. White colored PLA filament was used as 3D writing material. Drawings of the outer evenings, printing preparation and printing stages were made and the results were recorded. The purpose of the circuit control unit is to protect the electronics of the device against environmental factors such as humidity, dust, etc.

3. Result

The cleaning of the sun loungers on the beaches is provided by the relevant personnel several times a day. With the Arduino-controlled sunbed disinfection device, the disinfection of sunbeds will be offered to

the user almost without the need for personnel, and it will be aimed to contribute to the improvement of hygiene conditions.

In the disinfected sunbed project, non-contact disinfection of the sunbed is provided. It was noted that 6 nozzles placed at appropriate angles on the recliner were working efficiently. Each nozzle can spray up to 50 cm and leave disinfectant on an area of about 30 cm or more.

Figure 13. The disinfection of sunbeds

4. Conclusions and Recommendations

During the test stages of the device, a pump capable of transferring 4 Liter of liquid per minute was tried and the desired pressure level could not be obtained from this pump. When we then tried another pump capable of transferring 16 Liter per minute on a 12V 4A power supply, the expected spray from the nozzles was achieved, but droplets were seen on the nozzles. The required spray level was achieved by deciding to try a better power supply and using a 19.5V 6A adapter.

Different nozzle models can be selected or adjustable nozzles can be used according to the purpose of the spray to be used in the project. A voice command system can be created together with the IR sensor to develop the project. If someone else wants to lie on the sunbed after using the sunbed, an audible warning can be given. The container of the circuit unit can be made more useful. In addition, if ABS filament is used instead of PLA, the strength of the Container will increase. The print quality of 0.15 mm or higher in a 3D printer will contribute to making the material more robust.

References

[1] ŞEN YAŞAR, KESKİN SONER (2019). Heat pump and future in Europe. Journal of Engineering Research and Applied Science, 8(2), 1177-1184., (Kontrol No: 6368490)

[2] "Sprey Nozul". https://www.spreynozul.com/sprey-nozul-115.html (erişim Haz. 08, 2021).

[3] "Kızılötesi sensör temelleri | Kızılötesi sensör ağı çalışıyor". https://www.rfwireless-world.com/Terminology/Infrared-sensor-basics-and-Infrared-sensor-working.html (erişim Haz. 15, 2021).

[4] Y. A. Badamasi, "The working principle of an Arduino", içinde *2014 11th International Conference on Electronics, Computer and Computation (ICECCO)*, Eyl. 2014, ss. 1-4. doi: 10.1109/ICECCO.2014.6997578.

[5] B. Bozdoğan, "Yeni Arduino Kartlarına Merhaba!", *Mucitiz.biz*, Tem. 02, 2018. https://mucitiz.biz/blog/yeni-arduino-kartlarina-merhaba/ (erişim Haz. 02, 2021).

[6] D. U. Abbasoğlu, "Dezenfektanlar: Sınıflama ve Amaca Uygun Kullanım Alanları", s. 12, 2009.

[7] G. Çetin ve Y. Balci, "COVID-19 PANDEMİ SÜRECİNİN TÜRKİYE'DE İSTİHDAMA ETKİLERİ VE KAMU AÇISINDAN ALINMASI GEREKEN TEDBİRLER", *İstanbul Ticaret Üniversitesi Sos. Bilim. Derg.*, c. 19, sy 37, Art. sy 37, Haz. 2020.

[8] L. Atay, "KOVID-19 Salgını ve Turizme Etkileri", *Seyahat Ve Otel İşletmeciliği Derg.*, c. 17, sy 1, Art. sy 1, Nis. 2020, doi: 10.24010/soid.723581.