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An approach for the design of an automatic hand sanitizing machine using fog sanitizer

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Abstract - *Since the onset of the COVID-19 pandemic, it is recommended to wash or sanitize ther hands several times a day. Also, there should not be much wastage of water or sanitizer. The scarcity of water pose more problems and excessive use of hand sanitizer can lead to dryness, cracks, redness or discoloration on skin and its flaking. It dangerous if it is ingested or gets into the eyes. To solve this problem, a system can be developed that allows to sanitize the hands without using more than 95% sanitizer. To disinfect with disinfectant or sanitizer, it should reach every millimeter of the hand. The machine designed is a fog-based system. When the user inserts the hands inside the box, the mist system activates automatically, converting the sanitizer into fog. After exposing the user to sanitizer mist for 5-15 seconds, the hands will be clean.*

Key Words: Pandemic, sanitization, fog, humidifier, Arduino-uno, Covid-19

1. INTRODUCTION

The project is fighting the coronavirus pandemic by regularly washing hands and keeping public areas clean, considering the useless access to sanitizer caused by regular hand washing and control measures. When the user's hand is placed in the specified position on the machine, the sensor is activated and the mist system is automatically activated, turning the sanitizer in the container into fog. The mist maker module works on the principle of piezoelectric effect. When a voltage is given to the crystal, it vibrates at high frequency and turns the sanitizer into a thick cloud of fog. The system is based on Arduino Uno R3 microcontroller board Dry Fogging is a relatively new disinfection method that uses liquid disinfectants. Since the droplets are in the form of ultra-fine dry mist, it prevent the chamber from falling easily onto the surface. Thus this provides a desirable quality for a disinfection chamber. This fog hand sanitizer can be used when widely. In densely populated cities and metropolitan areas, there are several public spaces such as hospitals, shopping malls, and theatre toilets in trains and airports. This system ensures proper sanitation and effective management of water consumption, while saving about 95%. Fog sanitizer can be used to wash your hands and maintain a non-contact environment. It also helps prevent the spread of the virus by allowing multiple people to have access to these affected public sanitizer bottles.

1.1 EXISTING SYSTEM

In the present system, in addition to the manually controllable sanitizer dispenser, the automatic sanitizer dispensers are widespread. In a manually controlled sanitizer dispenser, there will be a direct contact with the dispenser which causes the spread of viruses or pathogens from one person to another. In the automatic sanitizer dispenser, the amount of sanitizer dispensed is over in quantity, so there will be a wastage of sanitizer and the over amount of sanitizer used several times will cause irritation and dry, cracked skin as well as redness or discoloration, and flaking.

1.2 PROPOSED SYSTEM

In the proposed system, the machine is integrated with a tank below it. The tank is filled with sanitizer. When the user inserts hands into the system, this automatically triggers a fog maker system that converts water in the tank to fog. The fog will reach all corners of the hand in less than 5 seconds as it is in gaseous state (water vapor). After 5- 15 seconds of sanitizer fog exposure the user's hand is free of any pathogens. This requires less than 95% of sanitizer and there is no direct contact with the system. The main advantage of the system is it delivers only standardized amounts of sanitizer which will reduce the wastage of sanitizer. UV LEDs are also installed in the system that has an ability to kill bacteria, viruses, mold, and fungi. It is a completely automatic system.

2. HARDWARE

The main hardware includes

1. Fog maker/ultrasonic humidifier
2. Arduino uno R3
3. 5v relay modules
4. Buck converter
5. SD card module
6. Ultrasonic sensor
7. I^2C LCD display
8. The PAM8403 amplifier
9. UV led
10. SMPS adaptor

2.1 Fog maker/ultrasonic humidifier

The ultrasonic humidifiers power circuit board with Atomizing Chip Moisture Film Humidification atomization machine is suitable for the atomization plate tablet with a diameter of 20mm. The principle of working of the ultrasonic Humidifier Piezoelectric Transmitter module is cavitation produced by sound waves. By providing a DC of 3-12V it will turn into a mini ultrasonic atomizer. The sound waves contain compression and rarefaction and due to extremely rapid movement, water droplets cannot sustain in their liquid state and get converted into vapor immediately. This vibration is produced by a piezoelectric filament. Piezoelectric transducer dipped in a water. When powered it vibrates according to the high frequency, electronic signal and produces mechanical oscillation. When the oscillation speed is increased to a high level then the water particles cannot follow the oscillating surface, and a momentary vacuum and strong compression occur. It results in the formation of explosive air bubbles (cavitation). At cavitation, broken capillary waves are generated. Tiny droplets of dimension 1-micron diameter break on the surface tension of the water and are quickly dissipated into the air. It then converted into vapor form and absorbed is into the air stream

Fig-1: Ultrasonic Humidifier

2.2 Arduino uno R3

Arduino is an open-source hardware and software company. Its hardware products are licensed under a CC-BY-SA license and software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL).

The Arduino Uno R3 is a microcontroller board is a removable, dual-inline-package IC from ATmega328 AVR microcontroller. There are 20 digital IO pins (among which 6 can be used as PWM outputs and 6 pins can be used as analog inputs). It is possible to load the programs onto it from the easy-to-use Arduino computer program.

2.3 5v Relay modules

A power relay module can be considered as an electrical switch that is operated by an electromagnet. The electromagnet in the module is activated by a separate low-power signal from a microcontroller. When the electromagnet is activated, it will pull itself to either open or close an electrical circuit.

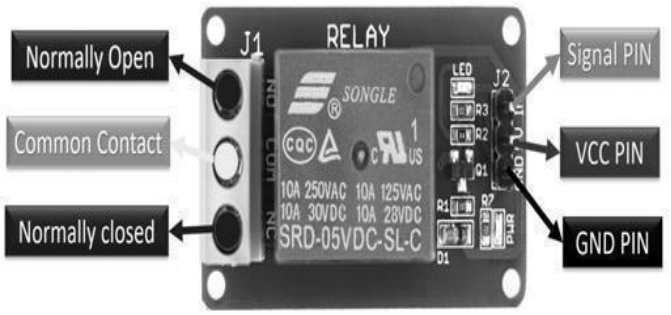

Fig-2: 5v Relay Pin Configuration

2.4 Buck converter

A buck converter (step-down converter) is a DC-to-DC power converter which steps down This module has onboard constant voltage and constant current control feature which is useful for general purpose power supply. There are two multi turn trim pots to adjust the output voltage and output current. Further, there are three LED indicators – the first one near the input connector is the constant-current (cc) indicator, while the next two LEDs are intended mainly for battery charging applications. By slowly turning the voltage adjustment trim pot clockwise direction will raise the output voltage gradually, and a counter clockwise rotation will lower it. Similarly for the current.

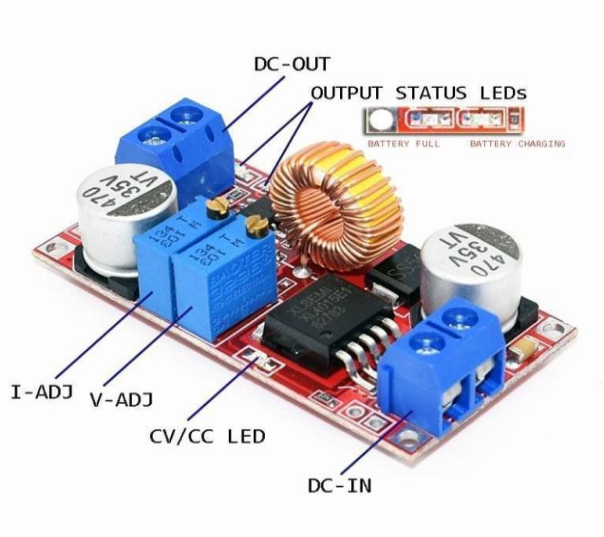

Fig-3: Buck Converter

2.5 SD card module

An SD Card Module or a Micro SD Card Adapter is a device which **allows connection between** a Micro SD card and a Microcontroller like Arduino.

2.6 Ultrasonic sensor

Fig-4: Pins Of Ultrasonic Sensor

An ultrasonic sensor is an electronic device that can measure the distance of a target object by emitting ultrasonic sound waves. It will convert the reflected sound into an electrical signal. There are two main components in ultrasonic sensors They are the transmitter that emits the sound using piezoelectric crystals and the receiver which receives the sound after it has traveled to and from the target.

2.7 I²C LCD display

The I2C 16x2 Arduino LCD Screen uses an I2C communication interface. It can display 16×2 characters on 2 lines, white characters on a blue background. This display overcomes the drawback of LCD 1602 Parallel LCD Display in which there is a wastage about 8 Pins on the Arduino for the display to get working.

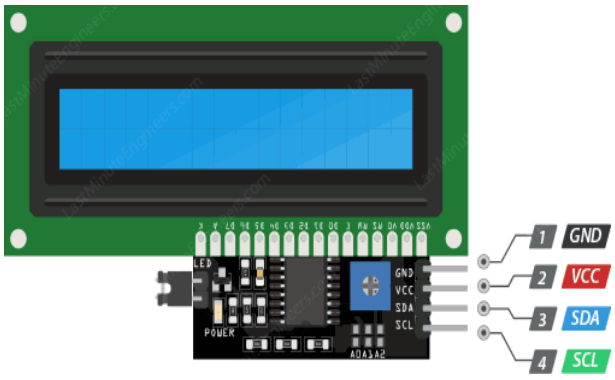

Fig-6: I²c Lcd Display Pinout

2.8 The PAM8403 amplifier

It is a dual-channel stereo amplifier that can produces 6W output. It has inbuilt short circuit protection. this IC itself does not require any kind of heat sink. It can directly drive 4Ω or 8Ω speakers. A proper speaker with not more than a 3W output rating must be used. This is a stereo amplifier board. The input section has two inputs L (Left) and R (Right) and common ground in between them. It does not require heatsink which also 25 saves additional board space. Irrespective of the heatsink.

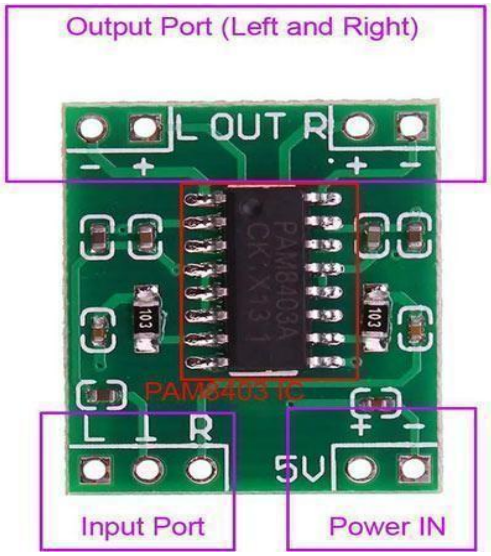

Fig-5: Pin description of Pam8403 amplifier

2.9 UV led

The germicidal effectiveness and use of UV rays is influenced by organic matter, wavelength, type of suspension, temperature, type of microorganism and UV intensity. UV-C is germicidal ultraviolet light. It works by deactivating the DNA inside bacteria, viruses, and other pathogens thus effectively stopping their capability to reproduce and spread disease. UV light in 200-280nm has the ability to kill bacteria, viruses, mold, and fungi.

2.10 SMPS adaptor

The SMPS Power Adaptor - 12V/2A is a Switched mode power supply SMPS. It is an advanced power supply. It provides low losses and stable output. There is no need of a rectifier. This high-quality Switching Power Adapter gives a clean regulated 12VDC output at up to 2A. They work with 240VAC input.

3. BLOCK DIAGRAM

The shape of the box is rectangular and it is made of plywood. The plywood is cut into several pieces and joined together in the shape of a box. Two holes are made in the front panel to insert our hands, and also a small rectangular shaped cut is made to place the LCD display. A speaker,dc switch and an smps adaptor plug is also fixed at the right side of the box. The box is divided into two chambers. The circuit part is placed in the lower chamber and the upper chamber comprises two containers that contain sanitizer. The fog maker floats on the sanitizer and it functions at its time. The division of the chamber helps to prevent falling the sanitizer droplets on the circuit and avoid the short circuit. The back side is openable, this way is used to stock the sanitizer into the container. A handle is provided on the back panel to open.

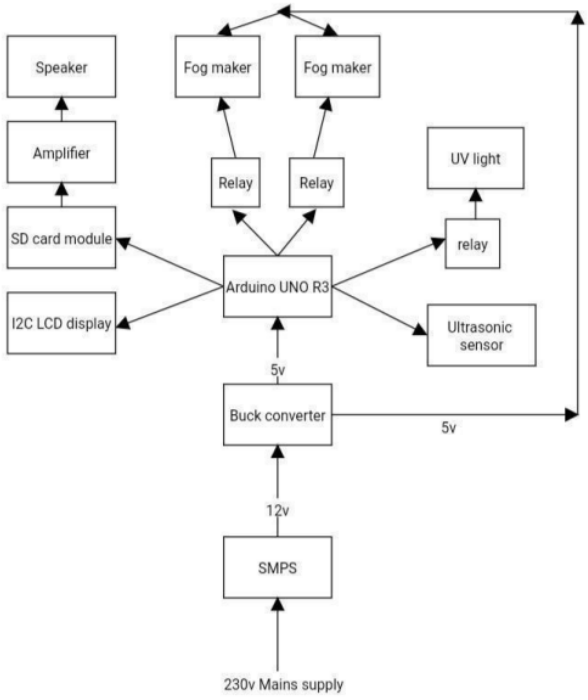

Fig-7: Block diagram

3.1 Steps to operate

STEP 1: Insert your hands through the two holes provided on the front panel.
STEP 2: check the input sensor for sensing
STEP 3: When the sensor senses the hands, the information goes to the Arduino and checks for the activation of the Fog Maker. At the same time, the UV light is also activated. The LCD display placed over the front panel displays ``please wait" to get our hand sanitized. The speaker functions with the LCD display which speaks the sentences shown in the display. If these are activated go to step 4 and step 5 otherwise repeat step 3.
STEP 4: The Disinfectant Solution is converted into the Fog.
STEP 5: We are ready to get our Hand Sanitized.
STEP 6: Check for the hand got sanitized by the machine. The LCD display and speaker says "Thank you for using the sanitizer dispenser". If the hand is sanitized, go to the next step. Otherwise repeat step 2.
STEP 7: When the process is done, the machine will stop and get ready for the next sensing.

4. CIRCUIT DIAGRAM

First the 230v ac coming from the line supply is given to the SMPS adaptor which converts the voltage into 12v dc. This 12v dc output coming from the SMPS is connected to the dc in pins of the buck converter which converts the 12v dc into 5v dc. This 5v is used to power all other components in the system. This 5v is connected to the Vin pin of the Arduino, and ground to ground pin. So the Arduino is powered. The ultrasonic sensor is fully connected with the Arduino such that the VCC pin is connected to the 5V pin of the Arduino. TRIG pin to pin 5, ECHO pin to pin 6 and ground to ground. The SDA pin of the I2C LCD display is connected to A4 pin of the Arduino and SCL pin to A5. The 5v is taken from the buck converter and ground to ground.

CS pin of the SD card module is connected to pin 4 of Arduino, CSK pin to pin 13, MOSI pin to pin 11, MISO pin to pin 12, The 5v is taken from the buck converter and ground to ground. amp in pin of the amplifier is connected to pin 9 of the Arduino. Speaker in pin is connected to the positive of the speaker,and negative to negative pin, the 5v and ground is connected to the buck converter.

Mist maker 1 is connected to the normally closed pin and common contact pin of the relay module and the signal pin of the relay module is connected to pin 7 of the Arduino. Mist maker 2 is connected the same as mist maker 1 but the difference is that the signal pin of the relay is connected to pin 3 of the Arduino. 34 Another relay module is also used for the UV LEDs. The normally closed pin is connected to the 3.3v pin of Arduino, common contact pin to the positive of the LED and negative to ground. The signal pin is connected to pin 2 of Arduino

5. PROGRAMMING LANGUAGE

The program is written in the Arduino programming language. Due to their simplicity, the programs written using the Arduino IDE are called sketches. To save and upload them to the Arduino board, we have to use the .ino extension. Arduino programming language has three main parts. First, functions that allow to control our board. Using functions, it is possible to analyze characters, perform mathematical operations, and perform various other tasks

– e.g., digitalRead() and digitalWrite() which help to read or write a value to a certain pin. Another two are setUp() and loop(). A sketch always starts with setUp(), which executes once after the power-up or reset our board. After creating it, use loop() to loop the program repeatedly until power-off or reset the board. Next, the Arduino values that represent constants and variables. Most of the data types (array, bool, char, float, etc.) are similar to those of C++. It is possible to perform type conversion as well. The structure, the last part of the Arduino language contains small code elements, such as operators.

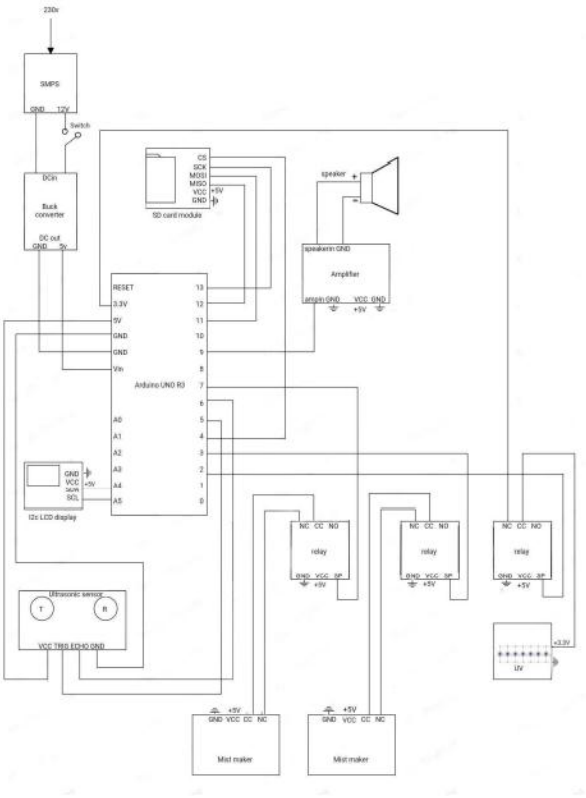

Fig-8: Circuit diagram

6. RESULT AND CONCLUSION

The proposed work has many important advantages and helps to kill viruses and bacteria in public places such as train stations, airports and theatres. Its portable design makes it easy to install and use in a variety of locations depending on your needs. The technology used is still new and very unstable. Using about 95% less sanitizer than traditional sanitising, it solves one of the wastage problems. The system is fully automated and avoids manual mistakes and spreading of viruses from one person to another. With this mechanism, people can operate them comfortably, contactless, and very hygienic.

Fig-9: Open view and front view of the product

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BIOGRAPHIES

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