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UV Sanitization Machine

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ABSTRACT: This project describes the evolving role of robotics in healthcare and allied areas with special concerns relating to the management and control of the spread of the novel coronavirus disease 2019 (COVID-19). The prime utilization of such robots is to minimize person-to-person contact and to ensure cleaning, sterilization and support in hospitals and similar facilities such as quarantine. This will result in minimizing the life threat to medical staffs and doctors taking an active role in the management of the COVID-19 pandemic. The intention of the present research is to highlight the importance of medical robotics in general and then to connect its utilization with the perspective of COVID-19 management so that the hospital management can direct themselves to maximize the use of medical robots for various medical procedures. This is despite the popularity of telemedicine, which is also effective in similar situations. In essence, the recent achievement of the Korean and Chinese health sectors in obtaining active control of the COVID-19 pandemic was not possible without the use of state of the art medical technology.

KEYWORDS: Covid-19, UV Tube, health

I. INTRODUCTION

In the amidst of this global pandemic, stepping in where humans should not, robots are being used for jobs such as sanitizing hospitals and delivering food and medicines, and have proved to be very much useful and handy. Each and every day as health workers, researchers and governments struggle to control the spread of the virus that has infected more than 22,053,135 people globally and claimed more than 777,489 lives [Last updated: August 18, 2020, 07:11 GMT]. robots are also being deployed for administering treatment and providing support to quarantined patients. The World Health Organization has advised physical distancing for people around the world to prevent community level transmission of Covid-19.
Sanitization, which has become a very important aspect in these pandemic times and plays a very crucial role in preventing us from exposure of this deadly virus and thus helping in eradication of this global pandemic is very important. One of the high-risk zones of exposure to this deadly virus is in the area where people rush to for the cure, that are the hospitals and the medical wards. Sanitization in these areas is indeed challenging and requires very high measures to be taken. But in spite of all these high-end measures taken, there is always a risk associated with it.

The objective of this project is minimizing human association as much as possible and thus automating the tasks such as sanitization with the help of robots. In this case, the use of robots can reduce human exposure to pathogens, which has become increasingly important as epidemics escalates. The project uses CATIA V5R20 software for its design and development of the sanitization robot. The design of the robot has a smile feature that helps in spreading positivity amidst these times.

PROBLEM DEFINATION :

UV Rays Exposed to human causes various skin& vision problem. So in order to minimize the exposure of humans to there is a need of development of conveyer equipped with UV TUBE
Robots are likely to be cheaper units that can relatively easily and quickly be adapted (eg, from other types of service robots) and that can focus on one aspect of the physical environment (ie, the floor) while humans work in parallel with them, eliminating issues around disinfection time.
Upgrading the conveyer system with UV-C sanitization unit can play a vital role to fight against the COVID-19

OBJECTIVES :

Following are the objective's of our project work :

1. Development of rigid conveyer Structure.
2. 25 kg load capacity motor driven conveyer
3. Utilization of UV-C tube for sanitization
4. Testing of complete project

SCOPE OF PROJECT WORK :

The scope of the present study is to design a smart medical assistant conveyer by exploring various technologies. The conveyer should be compact for efficient handling and incorporate a

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quick learning real time environment recognition technology for its locomotion in a crowded hospital.

II. LITERATURE REVIEW :

A few research papers related to medical robots have been reviewed and the following references show influence on the design of the smart medical assistant robot**. Marcin Zukowski et al** [1] have developed a humanoid medical assistant and companion robot dedicated to children hospitals. They have focused on the robot being able to express emotions and communicate with the children by recognizing their faces and using pictures and text on the chest display to tell stories and present educational videos. The 'Bobot' through hospital rooms and performs simple medical tests like measuring patient's body temperature or heart rate and sends live video feed to the doctors and nurses. The robot is run using ODROID XU and XU4 with Ubuntu 14.04 operating system and has a dedicated Raspberry Pi 2 computer to animate the robot's eyes.

Marcin Zukowski et al [2] presented the implementation of patients' temperature measurement system for the medical robotic assistant. They have experimented with MLX90614 infrared thermometer and FLIR Lepton thermal camera and found out that the MLX90614 infrared thermometer cannot be used as the only input source of the system and to get more accurate results, robot would need to come as close as less than 0.3 metres to a patient's face. To overcome this they created a hybrid system having infrared thermometer to provide ambient temperature and approximate skin temperature that can be used to detect presence of humans in front of the robot.

The paper by **Himadri Nath Saha [5]** et.al, propose a IoT Based alarm system for Garbage Monitoring and Clearance. This system has a level sensor to monitor the garbage level in the bin and when the level is reached, it alerts the municipality officials. An android app is developed for connectivity. The Microcontroller is Arduino Uno and the system takes energy from a solar panel. This deice has RGB Lights to indicate the exact level of the garbage.

COMPONENTS & SPECIFICATION:

UV LIGHT : UV light connected to separate power supply via relay and switched on by electronic trigger generated from Arduino. Here UVC lights are being used as it is effective for the destroying pathogens and other bacterial, virus present in air and moisture. From relays UVC lights are connected and when trigger from Arduino is given, switch is closed in relay and UVC lights are ON.

Fig. 6. UV-C device working. A video showing the setting up of the device is included in the supplementary material.

CAD DESIGNED USING CATIA V5R20 :

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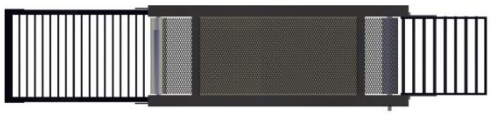
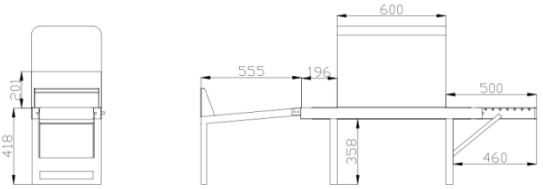
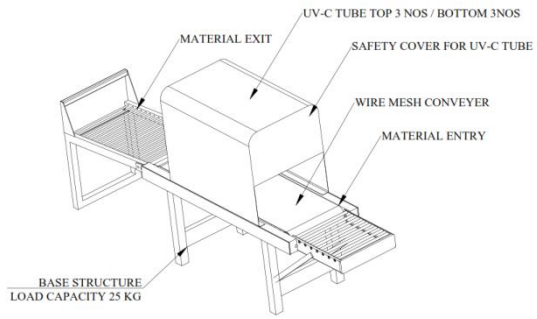






Experimental Working :

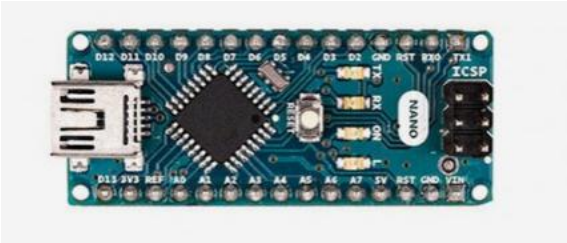
Working of our project is very easy for handling. Controlling of project is easily and effortlessly.

Object once placed on the surface of conveyer , the object moves forward. When the object comes in the UV-C area proximity sensor activates & the relay switches the UV-C tubes. Disinfection process remain ON until the object in inside the disinfection area. Duration of disinfection can be adjusted by controlling the speed of the conveyer.

COMPONENT USED OF MAKING PROJECT ARE

1. Nano arduino

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x).



2. Ultrasonic sensor

This Ultrasonic Sensor module is a transmitter, a receiver and a control circuit in one single pack!! It has a very handy and compact construction. It offers excellent range accuracy and stable readings in an easy-to-use package.

3. Relay

The Single-channel 5V 30A Relay Module power failure relay is a 1-channel relay module board with LED indicators, It can be controlled by microcontrollers such as Arduino, AVR, PIC, ARM any other microcontroller operating at 5V.

4. UV-c tube

Electronic Kit assembly :

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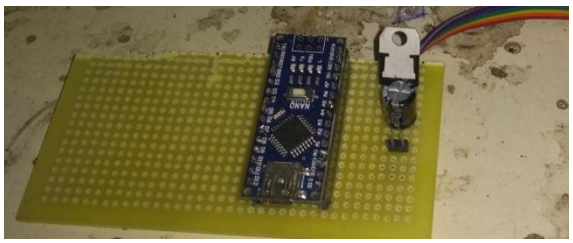
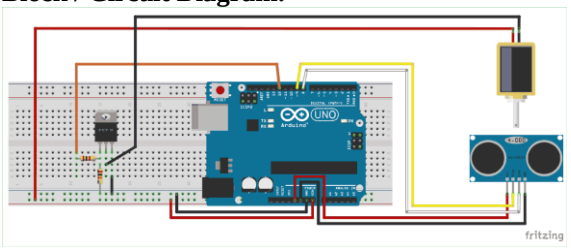


Block / Circuit Diagram:



Programming:

arduino Program

The following program is used :

```
#define trigger 5
#define echo 4 #define Relay 6 float
time=0,distance=0;
void setup()
{
Serial.begin(9600);
pinMode(trigger,OUTPUT);
pinMode(echo,INPUT);
pinMode(Relay,OUTPUT);
delay(2000);
} void loop()
{
measure_distance();
if(distance<5)
{
digitalWrite(Relay,HIGH);
}
else
{
digitalWrite(Relay,LOW);
}
delay(500);
}
void measure_distance()
{
digitalWrite(trigger,LOW);
delayMicroseconds(2);
digitalWrite(trigger,HIGH);
delayMicroseconds(10);
digitalWrite(trigger,LOW);
delayMicroseconds(2);
time=pulseIn(echo,HIGH);
distance=time*200/20000;
}
```

CONCLUSION

This study presents a comprehensive overview of the robotics potential in medicine and allied areas with special relation to the control of the COVID-19 pandemic. Effective management of COVID-19 can significantly reduce the number of infected patients and casualties as witnessed in the case of the Chinese outbreak. Since, it has currently turned out to be a global challenge, technologically advanced countries can aid others by donating support equipment and robotic infrastructure to enable a good outcome in controlling this disease. This review substantiates that the introduction of medical robotics has significantly augmented the safety and quality of health management systems compared to manual systems due to healthcare digitization. Classification of medical robots is only done using application-based categories to fit every aspect of hospital service ranging as well as fault tolerant control and dependable architectures for reliable and safe operation within the healthcare facilities.

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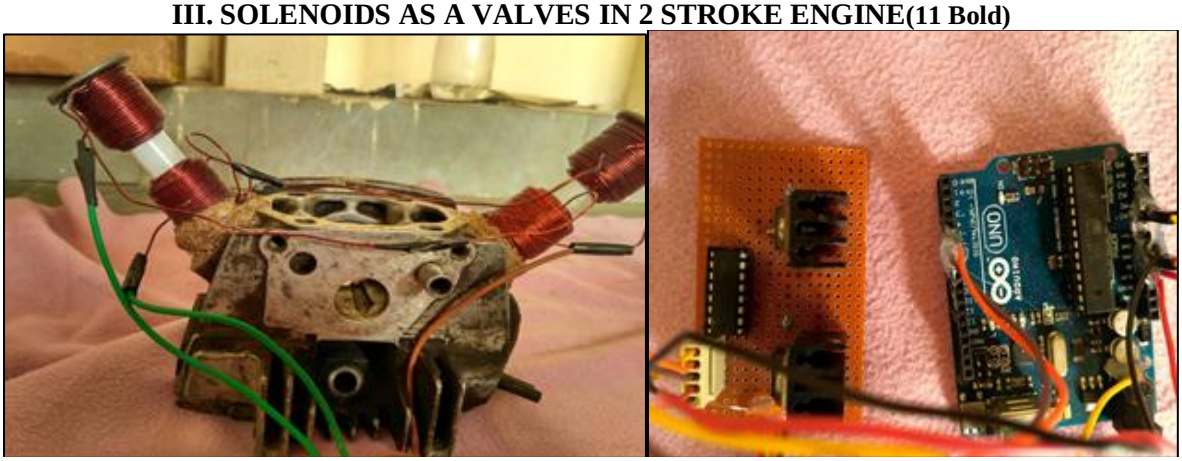
III. SOLENOIDS AS A VALVES IN 2 STROKE ENGINE(11 Bold)



A **solenoid** is simply a specially designed electromagnet. A solenoid usually consists of a coil and a movable iron core called the *armature*. Here's how it works. When current flows through a wire, a magnetic field is set up around the wire. If we make a coil of many turns of wire, this magnetic field becomes many times stronger, flowing around the coil and through its center in a doughnut shape. When the coil of the solenoid is energized with current, the core moves to increase the flux linkage by closing the air gap between the cores. The movable core is usually spring-loaded to allow the core to retract when the current is switched off. The force generated is approximately proportional to the square of the current and inversely proportional to the square of the length of the air gap.

When an electrical current is passed through the coils windings, it behaves like an electromagnet and theplunger, which is located inside the coil, is attracted towards the centre of the coil by the magnetic flux setup within the coils body, which in turn compresses a small spring attached to one end of the plunger. The force and speed of the plungers movement is determined by the strength of the magnetic flux generated within the coil.

When the supply current is turned "OFF" (de-energised) the electromagnetic field generated previously by the coil collapses and the energy stored in the compressed spring forces the plunger back out to its original rest position. This back and forth movement of the plunger is known as the solenoids "Stroke", in other words the maximum distance the plunger can travel in either an "IN" or an "OUT" direction, for example, 0 to 30 mm

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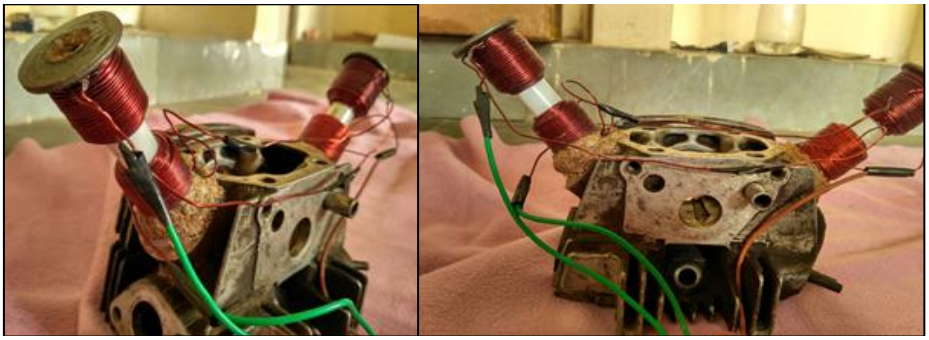
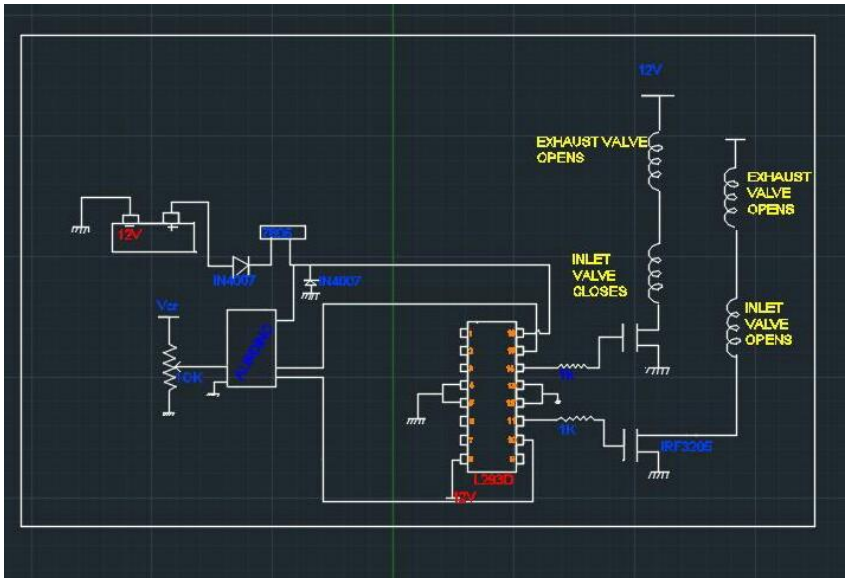


Side View and Front view of Solenoid Operated CamlessEngine

IV. EXPERIMENTATION

A Regulated 5V DC power supply is feed to Arduino board and IC 7805 Voltage regulator. All microcontrollers operate at low voltages and require a small amount of current to operate while solenoids require higher voltages and current. Hence current cannot be supplied to the solenoid from the microcontroller .This is the primary need for IC L293D.A diode(**IN4007**) and a voltage regulator (**7805**) IC are connected in the path ,the diode is used as a one-way check valve. Since these diodes only allow electrical current to flow in one direction.IC 7805 is a 5V Voltage Regulator that restricts the voltage output to **5V** and draws 5V regulated power supply. A digital signal generated by Arduino based on the input program is feed to the L293D IC .L293D Is a voltage amplifier that amplifies the 5V into 12V.The L293D IC receives signals from the micro controller and transmits the relative signal to the solenoids .A L293D IC consists of 16 pins in total. 4 ground pins,4-input pins,4-output pins,2 voltage and enable pins. The digital signal output from 7 pin of arduino is feed to 10^{th} pin of L293D(input),output from 7^{th} pin is feed to 14^{th} pin of L293D(output).The 4^{th},5^{th} and the 13^{th},12^{th} pins of L293D are grounded. L293D has an enable facility which helps you enable the IC output pins. If an enable pin is set to logic high, then state of the inputs match the state of the outputs. If you pull this low, then the outputs will be turned off regardless of the input statesDepending upon our power requirements we can use Transistors/MOSFETs as switches.



LINE DIAGRAM FOR VALVE ACTUATION OF CAMLESS ENGINE

The MOSFETs used are (IRF3205) which act as current amplifiers and amplify the current from 1 amp to 3 amps. Two solenoids are placed on the inlet and exhaust valves the piston of the solenoid is directly connected to the valve using a rubber tubing for motion transfer. Each solenoid consists of two set of copper windings with 12 mm dia,20 turns and 8 layered both the solenoid are oppositely connected and when actuated two sets of

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opposite windings get magnetized ,the piston inside solenoid moves up closing the valve the alternate valve is opened. The solenoids are rigidly placed over the cylinder head with the help of wood powder and glue which turns into concrete strong upon drying up. A solenoid is simply a specially designed electromagnet. A solenoid usually consists of a coil and a movable iron core called the *armature*. Here's how it works. When current flows through a wire, a magnetic field is set up around the wire. If we make a coil of many turns of wire, this magnetic field becomes many times stronger, flowing around the coil and through its center in a doughnut shape. When the coil of the solenoid is energized with current, the core moves to increase the flux linkage by closing the air gap between the cores. The movable core is usually spring-loaded to allow the core to retract when the current is switched off. The force generated is approximately proportional to the square of the current and inversely proportional to the square of the length of the air gap.

SOURCE CODE FOR THE MICROPROCESSOR:

```
intex_valve = 7;
intin_valve = 6;
intspd_ctrl = A0;
int del,del1;
void setup()
{
        pinMode(ex_valve,OUTPUT);
        pinMode(in_valve,OUTPUT);
        pinMode(spd_ctrl,INPUT);
        digitalWrite(ex_valve,HIGH);
        digitalWrite(in_valve,HIGH);
}
void loop()
{
        del=analogRead(spd_ctrl);
        del1=map(del, 512, 0, 512);
                if(del1<=20){del1=20;}
                if(del1<=500){fire();}else
        {
                digitalWrite(ex_valve,HIGH);
                digitalWrite(in_valve,HIGH);
        }
}
void fire()
{
                digitalWrite(ex_valve,HIGH);
                digitalWrite(in_valve,HIGH);
        delay(del1);
        digitalWrite(ex_valve,LOW);
        digitalWrite(in_valve,LOW);
}
```

V. OBESERVATIONS FROM THE TESTS CONDUCTED SOLENOID FORCE

The actual force required in the application is need to move the engine valve along with spring that must be considered.

The force can be calculated by:
$F = (N*I)^2 \mu_0 A / (2 g^2)$,
Where:

- $\mu 0 = 4\pi 10\text{-}7$
- F is the force in Newtons
- N is the number of turns
- I is the current in Amps
- A is the area in length units squared
- g is the length of the gap between the solenoid and a piece of metal.

For different N values we get different solenoid force for valve operating
I=5amp, g=0.5, A=πdl. (d =2mm,l=5cm,)

SL.NO	NUMBER OF TURNS	SOLENOID FORCE	VALVE FREQUENCY PER SECOND
1	100	0.512 N	14
2	120	0.738 N	18
3	140	1.001 N	22
4	160	1.310 N	25
5	180	1.661 N	28
6	200	2.050 N	33

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Valve Frequency
At average speed i.e the valve opening or closing time is 40ms
For 1 sec 25 openings and closings is possible
For 1 min for one valve 25*60=1500
With a force of 1.31N the inlet valve opens for 1500 times and exhaust valve opens fo 1500 times.

SL.NO	TIME TAKEN FOR ONE OPENING OR CLOSING IN MILLI SECONDS	NO OF OPENINGS OR CLOSINGS IN ONE SECOND	NO OF OPENINGS OR CLOSINGS IN MINUTE
1	71.4	14	840
2	55.5	18	1080
3	45.45	22	1320
4	40	25	1500
5	35.7	28	1680
6	30.30	33	1980

VI. CONCLUSION

Looking back on this project, the overall outcome of results to be observed. This can be evaluated by looking at how well our objectives were met. Our first objective is to control the engine valve of an engine, select a linear actuator that meets specifications, and construct an electronic control system, deal with the design aspect of our project and were all almost achieved. More specifically, next objective, the electronic control system we constructed is able to read engine speeds from 0 to 3600 rpm and vary the valve timing depending on engine speed and operator inputs. However, our final objective, to obtain gains in horsepower, torque, and efficiency of 2% was not met because of not setting up in an engine but theoretically it should be done. We are confident though that this objective of installing in an engine can be met if more time for testing and facilities is given. There is a lot we could say about the need for variable valve timing. This design is very realistic for the future of the automotive industry as well as our education.

SOME OF THE ADVANAGES FROM THE ABOVE RESULTS
a)Eliminated Mechanical Linkages
b)It can make Engine clean , efficient and responsive
c)ECU can control the valve velocity acceleration and deceleration of valve
d)Reduction in size and weight
e)Fuel economy Increases
f)Power and Torque increase

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