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Design and Development of Robot for Sanitization of College Campus

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ABSTRACT- The world is severely affected by the Covid-19 pandemic health-care workers are hostile to work inside of COVID-19 hospital due to social distancing. Supplying essentials food and delivering medicine in hospitals has a challenge. To address the need of the World health organization and the certified sanitizing system is a solution for personnel and surface decontamination. To overcome the problem developed automatic portable sanitizing equipment for spraying sanitization solution. The portable sanitizer unit is attached to the top of the mobile robot. The system integrates a sprinkler mechanism and is used to distribute air and disinfectant fluid mixture. The mobile robot main components consist of a DC motor, Bluetooth module, Arduino, Motor driver, Submergible pump, Sprinkler, Battery, DC Converters are used. The system is capable of sanitizing the floors of hospitals. The application area can include hospital corridors, medical shops, operation theatre, walking pathways, doctor room, testing center, and patient room, etc.

Keywords: Covid-19; Hypochlorite; DC motor; Bluetooth; Arduino.

Introduction:

The robot can play an important role during the present pandemic situation. It reduces human involvement in all areas starting from a patient check-up to a medicine delivery system [1]. Health organizations were also instructed to maintain social distancing from corona positive found people. It is the biggest challenge for doctors and health care support workers. The government and medical workers are working day and night to protect the people from infection and infected people. During this pandemic situation, many hospitals are facing the biggest issue is a shortage of labourers, and many healthcare people afraid to enter the patient room. Unfortunately, everyday hospitals need to clean their floors for disease prevention and maintain hygiene. Recently many high-risk and high-touch areas, intelligent navigation, and detection systems are used. Further, Robot also used in modern farming to increase productivity. Zant et al. (2018) [2] designed an agricultural robot for greenhouse mildew treatment operations. This system allows the farmers to specify their farm, including fields, roads, and docking stations. In recent days house cleaning robots are famous for the hygiene room cleaning system. Asafa et al. (2018)[3] developed a vacuum cleaner robot for household applications. They fabricate disk type robot attached with

Vaccum and cleaning tools. In the system, it sucks dust via a folding dust bin on top, and a cooling fan is also mounted. The robot navigation via two motor controlled rear sweepers had each driven by 3v DC Motor. This compact type of robot making cleaning is a fully autonomous duty.

The application of robots arisen in all the fields, types such as wheeled mobile robots, legged robots, flying robots, robot vision, artificial intelligence, and so on. Some robots can walk, jump, and fly. Rubio et al. [4] reviewed the mobile robots in the aspects of the concept, framework, and applications. Mobile robots have the ability to move independently, with adequate intelligence to respond and make a decision based on the opinion received from the situation. Normally, any robot fabrication consists of locomotion, perception, cognition, and navigation. Vehicle movement problems are rectified by understanding the mechanism and kinematics, dynamics, and control theory. The sensitivity of the mobile robots depends on signal analysis, computer vision, and sensor technologies. Cognition is the process of analyzing input data from sensors and taking consistent action to achieve the purpose. Navigation systems require knowledge of positioning, starting point, and stopping point. According to the locomotion system, mobile robots can be classified as stationary, Land-based, Air-based, and water-based, etc.

A robot can help a human being in various applications and risky operations in difficult and fickle situations such as fire rescue, anti-terrorism, and removing explosives, etc. Cui et al. (2016)

[5] analyzed the wheel /track mobile robot mechanism design and Mobil ability. A flat ground transformable wheel track is used to analyze the mechanical structure of the wheel based robot. In this vehicle structure, the two sides of the driven rod maintain the symmetry of the motion and double four-bar linkage mechanism used in the track expansion and contraction situations.

2.1 Materials & Methods

The robot is capable of effectively killing microorganisms on the floor, such as fungi, bacteria, and viruses, and has significant effects on harmful microorganisms [6]. The robot cans automatically patrol for sterilization and disinfection in a predetermined area. The sprinkler is equipped with a double-acting pneumatic cylinder, and the purpose of the cylinder is used to pushes the air into the tank [7]. The main components consist of a sprinkler robot, is DC motor, Bluetooth module, Arduino, Motor driver, Submergible pump, Sprinkler, Battery, DC Converters. The frame is made up of a 3mm Galvanized iron sheet with a dimension of 440 mm length and 240 mm width. The frame acts as a base and is used to assemble all the components.

2.2 Control system

Lpc2148 microcontroller is used to control the sprinkler unit. It is used to control the mobile robot’s mechanical structure and comment to perform the desired objectives. The purpose of the control system is mainly perception, cognition, and action. The perception system provides information about the outside atmosphere. Based on the output data, appropriate commands are sent to actuators, which activate the mechanical structure.

2.3 The important unit of a mobile robot is the navigation system. This system has three types path Motion Planning

Path planning is essential for mobile robots to reach the target without any disturbance and collision. Trajectory tracking, path following remotely operated wheel-based robots are an important part of motion planning. Light-based sensors are used in the sprinkler robot.

In specific infrared sensors are used to identify obstacles through distance measurement and vision systems [8]

tracker, obstacle detection system, and remotely operated system. The objective is for the robot to move from one place to another place to complete the assigned task. HC-05 is a Bluetooth module that establishes a wireless network, The specification of this module is operating frequency is 2.4GHZ, and the operating voltage is 3.3v why we preferred these modules. These modules require less power, and the execution speed is also very high compared with other processors.

Wheel System

The choice of wheel types and number of wheels for a mobile robot is strongly linked to the choice of wheel arrangement. In sprinkler robots, four wheels have been selected because these robots are more stable than two or three-wheeled robots. In this type of wheel system, the center of gravity is located inside of the rectangle. The wheel is made up of polyethylene material and which is harder and more durable than many polymeric materials. The wheel geometry designed suitable for high velocity in flat floors.

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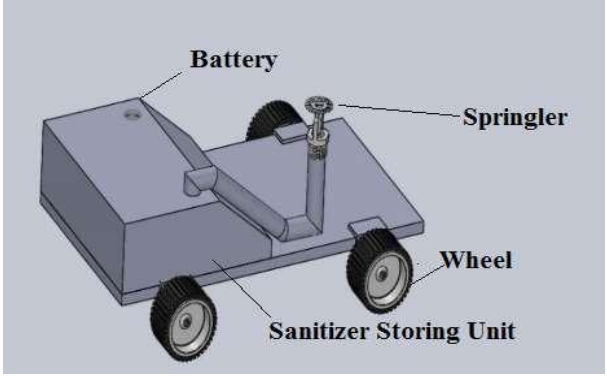
2.4 Battery

A battery is an electrochemical device that converting electrical energy into chemical energy. Normally three types of batteries are used in mobile robots such as Lithium-polymer, Lithium-

ion, and Alkaline [9].12V Lithium-ion battery is used in the sprinkler Robot. These batteries provide longer storage capacity and durability.



The sanitizer tank is made up of poly ethylene material with capacity of 3 litres.

Remote Operating System

Commonly wheel-based robots face some difficulties when traveling in complex environments such as steps and obstacles area [10]. To avoid this problem, vision systems and remote-based wheel operating systems are used in mobile robots. The working principle of the automatic sanitizer sprinkler robot is similar to a Television remote. When pressing the button in the remote, it obeys the input signal through the app. Initially, the input data reaches the Bluetooth module, and then the signal goes to the Arduino module. The Arduino program passes the commands to the motor drive. During the forward and backward stroke of the cylinder, air enters inside and moves the sanitizer outside of the tank.

FORWARD-F

Forward function F button allows robot to move forward when user gives F command in terminal mode.

BACKWARD-B

Backward function B button allows robot to move backward when user gives B command in terminal mode

LEFT-L

Leftward is the function used in Loop block it allows robot to move left side when user gives L command in terminal mode.

Rightward is the function used in Loop block it allows robot to move right side when user gives L command in terminal mode.

PUMP START-O

Pump Start is function used in Loop block it allows to start pump when user gives O command in terminal mode

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PUMP STOP-G

Pump top is function used in Loop block it allows to stop pump when user gives G command in terminal mode

Results and Discussion

Design Calculations

Sprinkler flow rate
Theoretical

Q=k √ p p=20 psi

k=5.6

Q=5.6 √20 Q 25 GPM

Q=Flow Rate (GPM), P=Operating PSI of head/Outlet K=K Factor of Head/outlet

Analysis

For 1 litre, the flow rate of the Sprinkler is 476seconds.

For the project the flow rate of the sprinkler is 200 seconds. The area of the sanitizer covered is 600mm.

The acquired Flow rate is 17GPM

Motor Specifications

Speed = 200 RPM, Voltage = 12V, Power = 100W Torque of the motor

Torque = (P X 60) / (2 x 3.14 x N) Torque = (100 X 60) / (2 x 3.14 x 100)

Torque = 9.554 Nm,

Torque =9.554 x 10^3 Nmm

Battery life calculation

Robot working hours for one full charge. Batter capacity = 12v 7Ah (Ampere Hours)

Total device consumption = 520ma (mill ampere)

Battery Life = Battery Capacity in mAh / Load Current in mA

= 7000mAh/520ma

= 13.46 HourS

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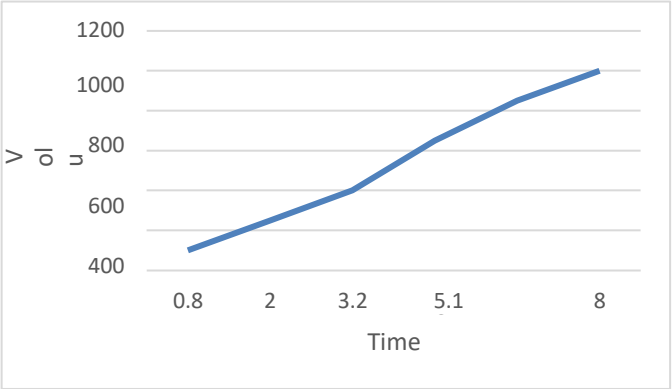
EXPERIMENTATION AND GRAPH:

Sr.no	Volume	Time
1	1000ml	8min
2	850ml	6.4min
3	650ml	5.1min
4	400ml	3.2min
5	250ml	2min
6	100ml	48sec



Here we tested the time required as per volume of liquid in the tank.

Fully filled tank of 1 liter sprayed for 8 mins before we had to refill it again

Sr. No.	Battery	Area Covered
1.	1000ml	16 sq.feet
2.	850ml	13.4 sq.feet
3.	650ml	10.8 sq.feet
4.	400ml	6.4 sq.feet
5.	250ml	4 sq.feet
6.	100ml	1.6 sq.feet

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SR.NO	Motors in use	Current Consumed by motor (Amp)	Battery Discharge time(+1%)
1	1 motor in use while turning right or left	0.56 Amp	2Hrs
2	2 motor in use while moving forward or revers	1.2Amp	64 min
3	3 motor in use while moving forward or reverse and also pump in working	1.82 Amp	47 min

Conclusion:

Autonomous mobile sanitizing robot is becoming most useful in COVID-19 hospital environments. It reduces the human intervention in sanitization. The designed system is very compact, so easily can transport this robot to any place. The COVID-19 pandemic presents even more reason to use mobile robots for safe cleaning in quarantine zones. The proposed

model is fabricated and tested in a hospital environment. The system is capable of disinfecting an area of up to 100 m^2 per day. By using the autonomous sprinkler system optimizes the disinfecting areas and reduces the wastage of sanitizer. The designed system is capable of sanitizing an area of up to 100 m2 per day. The application area can include hospital corridors, medical shop, operation theatre, walking pathways, doctor room, testing center, and patient room, etc.

Appendix

ARDUINO

Programming

```
#include<SoftwareSeria
l.h> int left_p=4;

int left_n=5;
 int
 right_p=6;
 int
 right_n=7;

    Software Serial my Serial (0, 1); // RX,
TX String data;

    intbt Val;
void  setup()
{

    Pin    Mode    (left_p,
OUTPUT);  Pin  Mode
(left,    OUTPUT);    Pin
Mode  (right,  OUTPUT);
pin            Mode(right,
OUTPUT);

    }
    void loop() {
    if (Serial.available()>0)
    {
    int signal = Serial.read(); switch(signal)


      {
```

```
        case ’F’: Forward ();
        break;
        case          'B':
    Reverse          ();
    break;
        default: break;
           }
           }
            }
          void Forward(){
digitalWrite (left_p, HIGH);
digitalWrite (left_n, LOW);
 digitalWrite(right_p, HIGH);
digitalWrite (right_n, LOW);
```

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