

Clinical Cleanliness Robot using Artificial Intelligence

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Abstract

Since COVID 19, the manufacturing of cleaning robots has exploded, ensuring the safety of patients and workers. Laboratories, public venues such as hotels, and public transportation all utilize cleaning robots.

When restrooms are not cleaned correctly, they become dangerous. Human health is jeopardized by filthy restrooms. For all humans, a clean environment is essential. Cleaning employees such as sweepers and scavengers suffer more ailments and infections as a result of manual cleaning. Furthermore, finding human labor for this type of cleaning work is quite tough anymore. Robots are being deployed all over the world to eliminate manual cleaning and scavenging. This research employs a fuzzy logic controller to create a clever intelligent robot that acts like a scavenger thanks to artificial intelligence capabilities such as neural network algorithms and powerful IoT characteristics. This research will be extremely valuable in the field of robotics, particularly in the cleaning of healthcare facilities, washrooms, and other such areas.

Keywords— Artificial intelligence. Neural networks, Clinical Research, Cleaning Robots

Introduction

Bacteria and viruses abound in hospitals and healthcare facilities. If we do not keep this atmosphere clean, it may result in an unhealthy environment for the hospital and the patients. One of the primary causes of different ailments is an unfavorable atmosphere. People's mindsets are terrible when it comes to keeping floors, washrooms, and toilets, among other things. Human labor is used to clean the toilets. Human labor is used to clean toilets, which is an inhumane practice. As a result, using a robot to clean the toilet is another viable option. We created a robot to clean both urinals and toilet basins in our suggested project. The robot is equipped with a variety of sensors, allowing for less human control. The robot is equipped with a line follower mechanism. A mobile machine that can recognize and follow a line painted on the floor is known as a line follower robot. The path is usually set and can be visible, such as a black line on a white surface with a strong contrast color, or invisible, such as a magnetic field. With its infrared ray (IR) sensors positioned beneath the robot, this type of robot should be able to detect the line. Following that, data is sent to the CPU through specialized transition buses. As a result, the Central processing unit will determine the appropriate commends and then send them to the driver, allowing the line follower robot to follow the route.

Our robot also has ultraviolet disinfection built-in, which can kill 99.9% of all bacteria in a hospital room in under 10 minutes. While the room must be vacant during disinfection, UV rays have no harmful effects. These robots do not take the job of cleaning workers, who must still remove "hard" stains like blood and urine.

The coronavirus catastrophe has hastened the use of disinfection robots, which have now spread from hospitals to hotels and public venues like airports and public transportation. However, the rise in antibiotic-resistant diseases is prompting a renewed focus on infection prevention, particularly in hospitals. According to the World Health Organization, drug-resistant illnesses cause at least 700,000 deaths each year, and this number is expected to rise to 10 million by 2050. This knowledge has prompted us to create and construct a robot to help us solve this difficult challenge.

Literature Review

The design of an automated Indian lavatory cleaning robot was described by Patil et al. The cleaning system had a minimal running cost and was completely automated. A robotic arm was employed to clean the toilet properly. They installed a toilet from India. The toilets were cleaned with a mixture of cleaning solutions and water. The real-time microcontroller ARM LPC 2148 was utilized.

A line follower mechanism guided the robot, and a counter kept track of how many times it was utilized, according to Arun Kumar et al. An RFID module is used to start the auto-flushing process. A robotic arm cleaned the toilet bowl completely. Aravindh et al created a low-cost automatic toilet cleaner that did not involve the use of manned robots. They mentally addressed the crowd, stating that individuals were not prepared to clean the restroom and that there was a personnel deficit.

Prem Kumar et al used a Gear motor to perform automated flushing. They employed a passive infrared sensor to operate the bathroom door, and a PIR sensor to verify if there was a guy inside the toilet. They used an olfactory sensor to measure the toilet's stink.

Gawande et al recognized that there was a cleaning lag in maintaining the cleanliness of washrooms in rural and urban locations, thus they chose to focus on cleaning washrooms in both rural and urban areas.

Alhaf Malik et al are working on the creation of an autonomous obstacle climbing robot that can scale a wall. The intelligent fuzzy logic controller makes use of this obstacle-climbing navigation method. The controller has two inputs and just one output. The slope and terrain type are the inputs, while the robot's speed is the output. The membership functions are the foundation of the fuzzy logic system and are critical to the mobile robot's functionality. They explore the effects of various membership functions, such as triangular and trapezoidal membership functions.

To clean the bowl, Kale et al employed numerous geared rack and pinion systems. The rack and pinion setups were processed using a high torque motor. They employed a brushing system for cleaning, as well as a combinational arrangement of pinion and rack links for forwarding and back movement.

Kinematics and Dynamics

The kinematics and dynamics of a medical robot are determined by the application. Surgical and rehabilitative robots, as well as service robots, employ serial and parallel robots for a variety of activities. The majority of hospital service robots are mobile robots with a large payload capacity but limited degrees of freedom (DOF). Surgical robots with several degrees of freedom, on the other hand, are versatile, accurate, and dependable devices that operate similarly to a well-trained human surgeon, with a limited error margin often within millimeters.

The control of medical robots is a difficult subject because it requires great accuracy, dependability, and repeatability while limiting the impact of external perturbations. Furthermore, designers must give enough degrees of freedom (DOF) for the end-effector to move in all of the necessary axes while addressing the difficulty of control and dexterity. Medical robots use cutting-edge technology to perform a variety of duties such as cleaning, sterilizing, transport, nursing, recuperation, and surgery. For the control and navigation of such complicated and nimble robots, adaptive robust embedded controllers are commonly used.

Disinfection

Robots used in healthcare and medical must be free of germs and microorganisms that might transfer communicable and infectious diseases toward other patients, thus they should have been well cleaned. Service robots must be sanitized regularly to avoid becoming pathogenic agents.

Operator Comfort

One of the most significant needs in medical and cleaning robots is operator safety, which is critical when using a robot in the health care sector focused. It should be safe for the operator, medical staff, physician/surgeon, and patient to have a robot near them at the clinic without causing a hazard to anyone. Surgical robots must comply with the safety criteria outlined in the IEC 80601-2-77 standard. This standard has been met by our robot.

Handling and care are simple

In hospitals, robots are meant to be operated by clinical professionals, physicians, and other employees who do not have engineering or technical abilities. As a result, for the long-term use of such devices, we offered a basic design with simple architecture, easy handling, and rapid maintenance.

Power Requirements

AC/DC power must be provided without interruption to run medical robots so that these important systems may continue to function. Because healthcare facilities range from large-scale city hospitals to purpose-built field hospitals, a variety of alternative energy sources are used to provide stable electricity.

Cost

Because therapeutic robotic solutions are required on a big scale, they must be cost-effective to allow for easy deployment and global availability. Cleaning robots utilize a dry vacuum and/or mopping to clean hospitals. Leaning robots for medical situations appear to be capable of delivering the innovation that non-industrial robot creators predicted years ago. These robots are used in clinical disinfection to eliminate bacteria and chemicals.

MATERIALS AND METHODS

To clean a global workspace map, a cleaning robot must explore the whole workplace. That is, a complete coverage navigation algorithm must exist, in which the cleaning robot navigates a full workspace in an unfamiliar environment only based on sensor data.

The strategy we suggest is innovative in the following ways

Using just sensor data, we offer a complete coverage navigation approach for cleaning robots in an unfamiliar environment. The cell-based technique and the template-based method are merged in the whole coverage path-planning strategy proposed in this research. The cleaning robot follows a series of predetermined rules on a cell-based map to repeat its journey from one cell to the next, allowing it to perform complete coverage navigation.

On a cell-based map, a cleaning robot usually advances to one of the adjacent cells from the current cell. The cleaning robot may travel in eight directions since all cells in the rectangular-cell-based model are square. The cleaning robot, on the other hand, can move more freely to avoid obstructions and follow an ideal course if the movement directions can be increased. As a result, we provide a triangular-cell-based map with 12 movement directions, allowing the cleaning robot to traverse with a shorter path and greater flexibility. Only the triangular cell has this benefit among the other polygons.

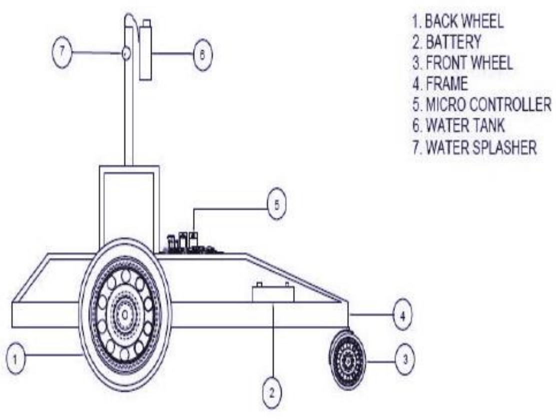

Fig: 1. Line Diagram

Our robot walks about hospitals on its own, generating UV-C light. If there is an unexpected movement that indicates a person entering the room, the robot will cease broadcasting. The robot creates a map of its surroundings using LIDAR sensors, which can then be marked up by an operator to identify which rooms and other places should be cleaned and which

should not. The robot then navigates around the facility on its own.
In our suggested invention, three methods of disinfection are feasible. Depending on the disinfection demands, UV, hydrogen peroxide, and plasma air filtration can be utilized alone or in combination. Because UV-C cannot pass through objects, it cannot clean surface areas that are blocked from view by other objects, whereas hydrogen peroxide misting is very effective for full surface coverage but takes longer and requires more intensive preparation, such as removing absorbent material and sealing ventilation points.

The TUG robots negotiate obstacles using a system of sensors, lasers, and waypoints from internally stored maps. Frame, DC motor, Spray nozzle, Toilet cleaning liquid tank, and Battery are the components used.
Sensors, Analog to Digital converters, processors, and motor drivers are the key components of the electrical framework. We employed eight sensors in the built robot, with appropriate spacing between them, and our competition line width was 18 mm. The signals received from the sensors are usually analog and must be converted to digital. As a result, the circuit may be constructed to feed the sensor signals directly to the CPU. The Atmel AVR microcontroller "At Mega 16" was utilized. It has a RISC core that runs single cycle instructions and a well-defined I/O structure. Some of the features include internal oscillators, timers, UART, SPI, pull-up resistors, pulse width modulation, ADC, analog comparator, and watch-dog timers. The IC L298 is an excellent motor driver that can control two motors. It's a 15-lead Multi watt and Power SO20 package with an integrated monolithic circuit. The L298 has a current capability of 2 amps per channel and can produce up to 45 volts. Furthermore, the L298 operates without a heat sink up to 16 volts. Three wheels are available to us. Two of them are connected to the motors and mounted on the robot's back, while the other is unattached and mounted on the robot's front as a passive caster. Aluminum has been employed for the chassis of the proposed robot since it is lightweight and sturdy enough for our project.

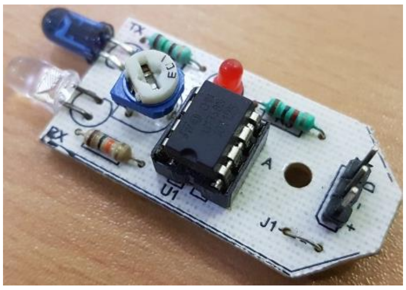

Fig: 2. Circuit Panel

The frame is built of lightweight aluminum. The entire assembly is installed on this frame construction in a suitable configuration. Boring of bearing diameters and open bores completed in one sitting to ensure appropriate alignment of bearings during assembly. Grease is made available to coat the bearings. The toilet cleaning robot is powered by a DC motor. The nozzle directs the toilet cleaning liquid from the collection tank to a specific location. The car is powered by a battery. The water is broken down into little particles using a sprayer. To save weight, all components can be mounted on the circuit fiber. Motors, for example, can be mounted beneath the fiber and other segments can be attached to the fiber. The robot's look isn't crucial. It should be highlighted that performance takes precedence over all other considerations. We've concluded that any form of adhesive should be avoided while installing components. As a result, the components may be simply screwed together.

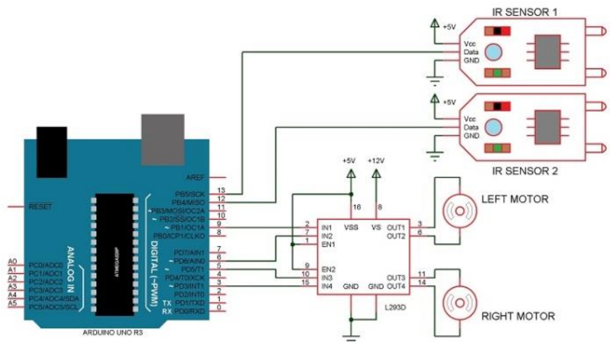

Fig:3. Circuit Diagram

Washing and cleaning with fuzzy logic control

Situations arise in our daily lives where we are unable to decide whether a state is real or untrue. The term "fuzzy" refers to something confusing or ambiguous. In AI, fuzzy logic gives you a lot of versatility when it comes to thinking. The following are the washing and cleaning rules:

1. If the toilet bowl is filthy, use extra water, a cleaning product, and a brush to clean it.
2. Use average water, average cleaning product, and average brushing if the toilet bowl is average.
3. If the toilet is clean, turn off the water, remove the cleaning chemical, and brush the toilet.

Fig:4. Cleaning Robot Outside view

CONCLUSION:

In a normal bathroom, the cleaning robot has been effectively installed. The robot will deliver water laced with a cleaning solution dependent on the level of dirtiness in the washroom. For the right input materials to the washrooms, a fuzzy logic controller is used. According to a hospital testimony, the system is faster and more cost-effective than allocating the duty to an individual. It has subsequently shown to be beneficial in decreasing the potential of cross-contamination on container surfaces while also allowing workers to focus on other tasks.

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