International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 6, Nov.-Dec, 2024 pp: 280-283 ISSN: 2584-2145
www.ijemh.com

Development of IOT Enabled Bacteria Measuring Floor Cleaner

Azizul Islam[1], Rahul Kumar Rai[2]
Asansol Engineering College, West Bengal [1,2]

Date of Submission: 01-12-2024 Date of Acceptance: 09-12-2024

ABSTRACT: In the era of smart technology, maintaining high hygiene standards is crucial for health and well-being. This paper presents the development of an IoT-enabled bacteria-measuring floor cleaner, a ground breaking solution combining advanced sensor technology and IoT to redefine surface cleaning. The system is designed to detect, measure, and eliminate bacterial presence on floors, ensuring thorough sanitation for residential, commercial, and healthcare environments. The device integrates a bacteria detection module using sensors based on fluorescence or optical techniques, capable of quantifying bacterial contamination on surfaces. An IoT-enabled interface connects the floor cleaner to a user-friendly application, providing real-time updates, contamination alerts, and cleaning efficiency reports. The automated cleaning mechanism incorporates traditional cleaning agents alongside UV-C sterilization for comprehensive disinfection. This smart cleaning system is powered by cloud-based data processing and analytics, allowing users to monitor cleaning patterns, assess bacterial trends over time, and optimize cleaning schedules. The integration of machine learning enhances bacterial detection accuracy and helps identify high-risk areas, making the system proactive and intelligent. The IoT-enabled floor cleaner addresses growing concerns about hygiene in high-traffic and sensitive areas such as hospitals, schools, and offices. By combining automation, connectivity, and real-time monitoring, it offers an innovative, efficient, and eco-friendly approach to modern cleaning challenges, promoting a safer and healthier environment.

KEYWORDS: IoT (Internet of Things), Bacteria Detection, Real-Time Monitoring, UV-C Sterilization, Automated Cleaning System, Sensor-Based Detection, Data Analytics

I. INTRODUCTION

Cleaning is an essential task that requires attention to every spot. While some areas are easy to clean, others can be more challenging. In certain cases, individuals are hired and compensated to perform cleaning tasks. However, there are situations where cleaning is necessary in hazardous environments, making it unsafe to deploy human workers. Additionally, large floor areas often demand multiple personnel for effective cleaning, which can be resource-intensive.

To address these challenges, advancements in science have introduced robots. However, many of these robots still require manual operation by personnel. To overcome these limitations, more advanced technologies are needed. Automation offers an excellent solution to these issues.

This paper focuses on developing an autonomous floor-cleaning robot powered by the Internet of Things (IoT) and Arduino programming. Modern households are becoming increasingly smart and automated, offering convenience and freeing up more time for individuals. Domestic robots are gradually becoming a part of everyday life, though this market is still relatively new and evolving. Nonetheless, the adoption of home automation and robotics is on the rise.

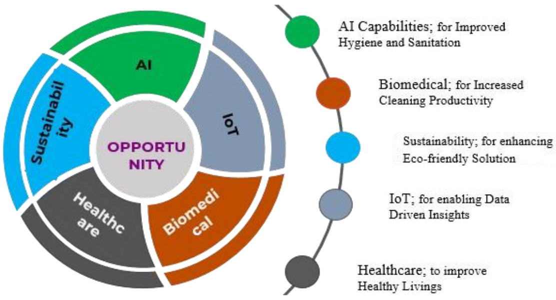

Fig 1.1 Technology for Healthcare and Bio-medical Solution

While several robotic vacuum cleaners are available on the market, only a few offer wet cleaning capabilities. The goal of this paper is to design and implement a vacuum robot that operates autonomously and can also be manually controlled via a smartphone application.

The vacuum cleaner robot aims to simplify the cleaning process by reducing reliance on manual vacuuming. The primary objective is to create a user-friendly robotic cleaning model using NodeMCU, a motor driver, and other components to achieve this goal. This innovative solution will enhance the cleaning experience, making it more efficient and accessible for users.

II. RELATED WORK

The development of floor cleaning robots has seen significant advancements in automation and IoT technologies. Early robotic vacuum cleaners, such as the Roomba, pioneered autonomous navigation using infrared and ultrasonic sensors for obstacle avoidance. Over time, these systems evolved to include features like SLAM (Simultaneous Localization and Mapping) for precise navigation.

IoT integration has further enhanced cleaning robots, enabling remote control, real-time monitoring, and smart scheduling through mobile applications or voice assistants. This connectivity has improved user convenience and aligned with the growing trend of smart home ecosystems.

Some advanced robots combine vacuuming and mopping capabilities for both dry and wet cleaning. However, the ability to monitor and measure bacterial contamination remains underexplored, limiting their effectiveness in ensuring hygiene. Certain systems incorporate UV-C light for sterilization, but they often lack bacterial detection sensors for real-time assessment.

Robots designed for hazardous environments, such as hospitals or industrial spaces, emphasize safety by minimizing human exposure. Efforts toward energy-efficient designs, including optimized battery usage, have also contributed to the sustainability of these systems.

Despite these innovations, the integration of IoT, autonomous cleaning, and bacterial detection into a single device remains a novel approach, presenting opportunities for impactful advancements in this field.

III. EXISTING METHOD

A robotic vacuum cleaner is an autonomous device that operates without human intervention, using self-driving capabilities to clean the floor. It is equipped with rotating brushes, a wiping function, UV sterilization, and surveillance cameras for effective cleaning. However, this vacuum cleaner has some limitations, such as frequently colliding with obstacles and stopping short of walls and other objects. It also struggles to reach corners and edges, often leaving these areas uncleaned. An automated floor cleaner robot, on the other hand, features side brushes to gather dust. It uses ultrasonic sensors to detect and avoid obstacles, adjusting its path accordingly. The robot also includes a suction unit to collect dust as it moves around the room autonomously. However, its main drawback is that it cannot clean wet floors.

IV. PROPOSED SYSTEM

The robot is activated by a simple switch, which starts the cleaning and mopping process. It follows a predetermined path, beginning at one end of the room and methodically cleaning the entire area. Once it reaches the opposite end, the robot adjusts its direction and proceeds along the opposite route to ensure complete coverage. If the robot encounters an obstacle, it changes its course to avoid it and continue cleaning. Additionally, the robot can be controlled remotely via a smartphone using Wi-Fi, allowing users to monitor or adjust its operation as needed. This combination of autonomous navigation and remote control enhances the robot's functionality and user convenience, making it an effective cleaning solution for various spaces.

V. WORKING MECHANISM

The autonomous cleaning robot is designed with low-power-consuming electronic components, allowing it to operate efficiently at minimal power levels. The key electronic components include the NodeMCU controller board, a voltage regulator IC, and a motor driver circuit. It features a filtration system that operates based on the principle of constrained vortex flow, similar to the functioning of a centrifugal pump. This generates centrifugal force, which draws in all types of debris through a pipe. The main advantages of using this robot include time savings and its practicality for individuals with mobility challenges, as it allows them to clean their homes effortlessly. Additionally, the robot is simple and cost-effective, making it an accessible cleaning solution.

Robotic cleaners are primarily categorized based on their cleaning capabilities, such as floor mopping or dry vacuum cleaning. These robots generate centrifugal force, which pulls in various types of debris through a pipe. The use of such a robot offers significant time savings and is particularly

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 6, Nov.-Dec, 2024 pp: 280-283 ISSN: 2584-2145
www.ijemh.com

beneficial for individuals with mobility challenges, enabling them to clean their homes effortlessly. Additionally, it is a simple, low-cost solution.

The floor-cleaning robot is designed to simplify the floor cleaning process. It can be particularly useful in environments like nuclear power plants, where harmful radiation can pose serious health risks. By deploying a robot for cleaning tasks, personnel can be kept away from dangerous areas. Similarly, in large spaces like colleges or industries, floor-cleaning robots can efficiently cover extensive areas without requiring human labor, saving both time and money.

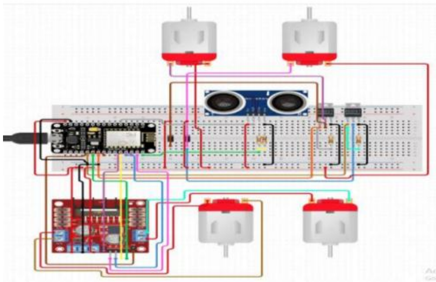

Fig 5.1 Circuit Diagram

The robot can be controlled via an Android app, typically developed using Java, though no prior Java knowledge is needed to use it. MIT App Inventor allows users to create the controlling app easily. While some functional enhancements that could improve robot performance may be omitted due to complexity or mechanical constraints, the robot is designed to perform autonomously with minimal human intervention. The goal is to create a robot that can navigate a room or house, effectively cleaning without extensive assistance.

VI. EXPERIMENTAL RESULTS

A hardware prototype has been developed with the goal of making the floor cleaning process more efficient, quick, and convenient, incorporating an Android mobile application for user commands. Testing of the robot has shown that it can successfully perform nearly all of the planned functionalities.

The robot can operate in both autonomous and manual modes, depending on the user's preference. In autonomous mode, the robot can be scheduled to start cleaning at a specific time and date. Once the set time arrives, it automatically begins cleaning the entire room and follows a pre-determined pattern. After completing its cleaning cycle, the robot returns to its starting point and self-cleans. In manual mode, users can control the robot to clean specific areas, conserving energy as needed. The user interface is designed to be simple and intuitive, allowing customers to operate the robot easily.

The floor cleaning robot aims to simplify the cleaning process, offering a more efficient alternative to manual cleaning. The primary goal of this paper is to design and implement a floor-cleaning robot, similar to those used in hospitals, utilizing NodeMCU for its operation.

Fig 6.1 Experimental Output

VII. RESULT AND DISCUSSION

The floor cleaning robot is designed to simplify the floor cleaning process. It can be particularly useful in environments such as nuclear power plants, where harmful radiation can pose significant health risks. By deploying a robot to handle the cleaning tasks, personnel can be kept away from these dangerous areas. Similarly, in colleges and other large spaces, the robot can efficiently clean expansive floor areas. In industrial settings, it can clean both large and small areas without the need for human labor, resulting in significant time and cost savings.

VIII. CONCLUSATION

In conclusion, the development of the IoT-enabled bacteria measuring floor cleaner using ultrasonic sensors and Arduino technology presents a significant advancement in cleaning automation. By integrating IoT capabilities, this system allows for real-time monitoring and control, offering increased convenience and efficiency for users. The ultrasonic sensors provide essential obstacle detection and navigation, enabling the robot to autonomously move and clean without human intervention. Additionally, the inclusion of a bacteria measurement system ensures that the floor is not only clean but also sanitized, addressing hygiene concerns effectively.

The use of Arduino technology makes the system cost-effective, while the IoT functionality enhances the overall user experience by enabling remote control and monitoring via mobile application.

This development is particularly beneficial in environments where hygiene and cleanliness are critical, such as hospitals, laboratories, and food processing areas, where traditional cleaning methods may be insufficient.

Moreover, the robot's ability to operate autonomously reduces the need for human labor, saving both time and effort. Future improvements could focus on enhancing the bacteria detection accuracy, expanding the cleaning capabilities to include wet cleaning, and refining the system's energy efficiency.

Overall, this IoT-enabled floor cleaning robot holds great potential for widespread use, providing a smart, efficient, and hygienic solution for various cleaning needs.

REFERENCES

[1] Uman Khalid, Muhammad Faizan Baloch, Haseeb Haider, Muhammad Usman Sardar, Muhammad Faisal Khan, Abdul Basit Zia1 and Tahseen Amin Khan Qasuria Faculty of Electronic Engineering, Ghulam Ishaq Khan "Smart Floor Cleaning Robot (CLEAR)" Institute of Engineering Sciences and Technology, Pakistan Hamdard Institute of Engineering & Technology, Hamdard University, Karachi, Pakistan 2015.

[2] Manreet Kaur, Preeti Abrol "Design and Development of Floor Cleaner Robot (Automatic and Manual) "International Journal of Computer Applications (0975 – 8887) Volume 97– No.19, July 2014.

[3] Yong-Joo Oh and Y. Watanabe "Development of the small robot for home floor cleaning", Proceedings of the 41st SICE Annual Conference, 5-7 Aug, SICE 2002.

[4] Xueshan Gao, Kejie Li, Yan Wang, Guangliang Men, Dawei zhou and Koki Kikuchi. A floor cleaner robot using Swedish wheels.In IEEE international conference on robotics and biomimetics December 15- 18, 2007, Sanya, China.

[5] H.G.T. Milinda and B.G.D.A. Madhusanka "Mud and dirt separation method for floor cleaning robot", Moratuwa Engineering Research Conference (MERCon), 29-31 May 2017, Moratuwa, Sri Lanka [6] J Frolizzi C.Disalvo. Service robots in the domestic environment: A study of Roomba vacuum in the home". In int. conference on human robot interaction HRI, PAGE 258- 265 March 2006.

[7] Manya Jain, Pankaj Singh Rawat "Automatic Floor Cleaner" International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 04 | Apr -2017 eISSN: 2395 -0056 p-ISSN: 2395-0072.

[8] Avinash Chahare, et. al. (2022). Design Modification and Fabrication of Eco-Friendly Cleaning Machine. International Journal of Advanced Research in Science, Communication and Technology,2, 750-756

[9] Shailesh Dhomne, et. al. (2020). Design and Fabrication of Manually Operated Floor Cleaning Machine. International Research Journal of Engineering and Technology,7, 4428-4436.

[10] T. Jayananda Kumar, et. al. (2020). Design and Fabrication of Wet and Dry Floor Cleaner with IOT Based Control. Journal of Emerging Technologies and Innovative Research, 7, 1070- 1075.

[11] Rupali Shinde, et. al. (2020). Automatic Floor Cleaner with UV Disinfection System. International Journal of Advance Research and

[12] P. Vignesh, et. al. (2019). Design and Fabrication of Smart Floor Cleaning Machine. International Journal for Research in Applied Science & Engineering Technology,7, 1985-1988.

[13] V.Vadivel, et. al. (2019). Design and Fabrication of Multi-Purpose Automatic Floor Cleaner. International Journal of Machine and Construction Engineering,6, 88-90.

[14] Balasaheb Kasure, et. al. (2019). A Review on Semi-Automatic Track Cleaning Machine. International Journal of Research in Engineering, Science and Management,2, 704- 707.

[15] Himani Patel, et. al. (2019). Wireless Multi - Purpose Floor Cleaning Machine. International Journal of Latest Technology in Engineering, Management & Applied Science,8, 16-19.

[16] Raveena Ishalavath M, et. al. (2020). Design and Development of an Automated Floor Cleaning Robot for Domestic Application. International Journal of Engineering Research & Technology, 8, 67-70.

[17] Saravanan N, et. al. (2020). Fabrication Of Floor Scrubber Machine. International Journal of Scientific & Technology Research,9, 2251-2253.

[18] M. Ranjit Kumar, et. al. (2015). Design and Analysis of Manually Operated Floor Cleaning Machine. International Journal of Engineering Research & Technology (IJERT), 04, 828-831.

[19] Dhiraj M. Bankar, et. al. (2017). Floor Cleaning Machine by Remote Control. International Journal of Innovations in Engineering Research and Technology [IJIERT], 04, 105-108.