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Report on

"IMPLEMENTATION OF DUST CLEANING ROBOT"

Submitted in the partial fulfillment of the requirement for the Project Evaluation Internal- I

Bachelor of Engineering

In

Electronics & Communication Engineering

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CERTIFICATE

This is to Certify that the project work entitled **IMPLEMENTATION OF DUST CLEANING ROBOT** carried out by **Mr. Akash kumbar (1NC21EC400), Mr. Arunkumar N (1NC21EC401), Mr. Chethan naik L (1NC20EC008), Ms. N Hema Latha (1NC20EC027)** a bonafied students of Nagarjuna College of Engineering and Technology, Bangalore an Autonomous college under Visvesvaraya Technological University, Belagavi, in partial fulfillment for the project work carried out by them for the course "Project Evaluation Internal-I" during the year 2023-2024.

It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report. The project report has been approved, as it satisfies the academic requirements of Project Evaluation Internal-I.

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ABSTRACT

Manual work is taken over the robot technology and many of the related robot appliances are being used extensively also. Here represents the technology that proposed the working of robot for Floor cleaning. This floor cleaner robot can work in any of two modes i.e. “Automatic and Manual”. All hardware and software operations are controlled by ARM7 microcontroller. This robot can perform sweeping and mopping task. RF modules have been used for wireless communication between remote (manual mode) and robot and having range 50m. This robot is incorporated with IR sensor for obstacle detection and automatic water sprayer pump. Four motors are used, one for cleaning, one for water pump and two for wheels. Dual relay circuit used to drive the motors one for water pump and another for cleaner. In previous work, there was no automatic water sprayer used and works only in automatic mode. In the automatic mode robot control all the operations itself and change the lane in case of hurdle detection and moves back. In the manual mode, the keypad is used to perform the expected task and to operate robot. In manual mode, RF module has been used to transmit and receive the information between remote and robot. The whole circuitry is connected with 12V and 3.3V battery.

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CHAPTER-1

INTRODUCTION

Robot is an electromechanical machine and used for various purposes in industrial and domestic applications. Robot appliances are entering in the consumer market, since the introduction of iRobots. Many related appliances from various companies have been followed. Initially the main focus was on having a cleaning device. As the time pass on many improvements were made and more efficient appliances were developed. In early, 2010 a new automatic floor cleaner robot “Mint” was developed by Jen Steffen. Detachable clothes were attached for sweeping and mopping purposes. For tracking mint used the GPS-like indoor localization system.

In this research work a floor cleaner robot based on ARM7 have been developed. This cleaner robot is an electric home appliance, which works in two modes as per the user convenience “Automatic and Manual”. Unlike other floor cleaner robots this is not a vacuum cleaner robot; it performs sweeping and mopping operation. Detachable mop is used for mopping. It works on 12V supply. In the automatic mode, robot performs all operations itself. Automatically, does not stop and starts cleaning action. To make whole system wireless, RF modules have been used in automatic and manual with 50m range. For user convenience automatic water sprayer is attached which automatically spray water for mopping, therefore no need to attach wet cloth again and again for mopping. Fan is used to dry the wet floor. Motor driver circuit has been used to drive the motors. Four motors have been used to perform respected operations like to move the robot, for water pump, for cleaner. Relays have been used to drive the water pump and cleaner motor. LM293D IC has been used to drive wheel motor. All the information displayed on LCD [1].

In the manual mode, user itself operates the robot. RF module has been used to transmit and receive the signal to operate the robot through remote. In the manual mode, if any hurdle detected, then signal of hurdle detection displayed on the LCD of remote via RF module. Movement of robot is controlled by user itself through keypads therefore user can move the robot in the desired direction. All the information displayed on the LCD. Since the dawn of this century, the market for cleaning robots have increased exponentially,

Reaching beyond domestic and industrial floor cleaning robots and into duct cleaning, facade cleaning and ship hull cleaning. Within the most widespread type of cleaning robots - floor cleaning robots, there exist many types as well, ranging from pavement sweeping robots, to staircase cleaning ones, to the common Robot, Enova's and Neato. The European Union has revealed that the market share of suppliers of such robots in the vacuum cleaner industry is projected to increase over the decade. Common cleaning mechanisms employed by floor cleaning robots include brushes, namely cup brushes, side sweeping brushes and rolling brushes, dry and wet mops, squeegees and vacuum units [2].

In the recent years, robots have been used for various cleaning purposes. Robots have various cleaning expertise like mopping, picking up the waste, wet floor cleaning, dry vacuum cleaning etc., Depending on the cleaning mechanism, these robots may have some advantages and disadvantages. Smart floor cleaning robot has been designed for home and office environments. This robot will be using water the storage with anti-infection solution which is pumped with water pump motor. This robot on receiving the commands from the android device cleans a area using a cleaning pad by spraying water on the floor. After cleaning the wet floor, it can drain the dirty water into the required container as per the commands given to it. The robotic arm is used for efficient and effective wet floor cleaning purpose. This system can also be used to pick up the objects and carry them within the Bluetooth range. The proposed system is a manual system because it is controlled by android application which is operated by human. The proposed system functioning is entirely depended on the commands that are received from the android app [3].

1.1 OBJECTIVE

- Implementing a dust cleaning robot involves a comprehensive approach, merging both hardware and software elements.
- Hardware components like sensors (ultrasonic sensors), motors, wheels or tracks, cleaning mechanisms (brushes, vacuums), and a power source constitute the robot's physical aspects.
- Software aspects include developing algorithms for navigation, obstacle avoidance, and environment mapping, often employing AI and machine learning for improved decision-making.
- The robot's objective revolves around efficient cleaning, autonomous navigation, and user-friendly operation.
- Achieving these goals demands a balance between hardware capabilities, like sensor accuracy and motor efficiency, and software intelligence, like robust navigation algorithms and user interfaces.
- Successful implementation involves iterative testing, refinement, and integration to create a reliable and efficient cleaning solution for various environments.

CHAPTER-2

LITERATURE SURVEY

J Frolizzi C. Disalvo (2006) advised an article called **"**A robot dust cleaner is an autonomous robotic dust cleaner" which includes self-drive mode and cleans the floor autonomously without human control. This robot dust cleaner consists of spinning brushes, mopping, UV sterilization and security cameras for cleaning purpose. This dust cleaner had some drawbacks like colliding with obstacles and stopped at a shorter distance from walls and other objects. It was not able to reach to all corners and edges of the room and left those areas unclean [3].

Youngkak Ma (2008) recommended a design on "Smart vacuum cleaner" in various platforms, but it isn't much convenient for the user and doesn't provide a particular algorithm [4].

Vaibhavi Rewatkar and Sachin T (2009) intended a design on **"**Bagde provided a comprehensive overview of the technological" advantages helped within the real world for the convenience of just about all of the people that are extremely busy. Consequently, this has led to arriving up with a goal of constructing an automatic home appliance. The review includes computerized cleaner having components to DC motor operated wheels, the dustbin, cleansing brush, mop cleansing and obstruction avoiding sensor. A 12V battery is employed for supplying power. Special technique of ULTRAVIOLET germicidal cleaning technology. The study has been done keeping in mind economical expense of product [5].

Manreet Kaur and Preeti Abrol (2014) recommended a design on "Came up with the working of automatic robot Floor cleaning". This automatic robot can add any of two methods. All hardware and software functions are handled by AT89S52 microcontroller. This automatic robot is in a position to perform sweeping and mopping job. RF modules is getting used for cordless communication between remote (manual method) and automatic robot has range of 50m. This robot is given with IR sensor for obstacle recognition and automates water sprayer pump. Four motors are being employed, two for cleaning purpose, one for pump and one for tires. Dual relay circuit is employed to work the motors one for the pump and another for the cleaner. In previous works, there's no use of automated water sprayer and works

only in programmed mode. With the automated mode automatic robot controls all the functions itself and alter the road if just in case there's

The expected job and operate automatic robot. In manual method, RF component is employed to transfer the knowledge between remote and automatic robot and display the data associated with the hurdle detection on LCD. The entire circuitry is associated with 12V electrical device pack [6].

Vinod J Thomas (2015) intended a design on "robot is designed for domestic application". The robotic contains a cleaning module which may be used for cleaning. The Robot was created in order that it may well be capable of reach almost every space and corner of any room that it must be as compact as possible. The working robot is handled using an Android phone using Wireless Bluetooth Technology. The robot was created with an Arduino microcontroller at its core. The microcontroller is complemented with communications modules like Wireless Bluetooth motors and dirt Suction System to work accordingly [7].

Prof. Ms. Swati Pawar (2016) recommended an article called **"**Earlier sawdust was used to remove water that spilled on the floor". Tea leaves were used to remove the dirt and odor on the carpets. As time passed on, broom sticks and mops were invented. Still it required manpower. The evolvement of vacuum cleaner helps the human to reduce the task of cleaning to an extent by sucking the dust particles. Even though requires the human attention. Later the emergence of room cleaning robot with random cleaning algorithm occurred but the system should monitor by the user and they failed to produce complete cleaning [8].

Manya Jain (2017) advised a design on **"**An automatic floor cleaner robot" has brushes attached to its sides to collect the dust. This robot uses ultrasonic sensors to avoid obstacles and change its direction and it has a suction unit that sucks in the dust while moving around the room freely. But the drawback of this robot is that it cannot clean the wet floor Roomba vacuum cleaner robot is arranged at 27o angle, the sweeping brush placed under it sweeps the dust and waste from corners and edges. It has a powerful motor suction unit which sucks in the dirt into the filtered dust bin. [9].

Aishwarya Pardeshi (2017) recommended a design on **"**This paper presents the look, developed and fabricated model of programmed cleaner robot". This type of robot performs automated function with extra features like choose and place mechanism and dirt container with air vacuum mechanism. This type of labor is straight forward and helpful in betterment of life variety of a mankind [10].

Rupinder Kaur (2017) intended a design on "A swabbing automatic robot" which is extremely good for cleaning jobs especially in homes, Office buildings, Industries where sanitation could be a significant matter. Many research organizations are active in locating the most effective results through the unreal intelligence. Certainly, artificial intellect could be a branch of technology which makes computers sounds like mind. This product will sweep, and mop the bottom area with clean and other wiping components; and yes it collects the dust particles and other small parts in it. Mapping is wont to instruct this small device. These devices are just too simple to use, very affordable and clean every nook of the region. Being autonomous, it could add one's absence [11].

S Monika, K Aruna Manjusha (2019) proposed an article called **"**The floor cleaning is worn out a neater way and efficiently by robot utilizing wireless system". This proposed robot saves the time and economy of labor. within the previous research papers like robot household appliance and automatic floor cleaner robot had some drawbacks like colliding with objects before of it and this vacuum couldn't reach to small areas and left those areas unclean and therefore the automatic floor cleaner robot collects the dirt but the downside up here is that it doesn't clean the wet floor. Few of the drawbacks during this project paper are overcome. Amit Sharma [12].

CHAPTER-3

METHODOLOGY AND BLOCK DIAGRAM

3.1 METHODOLOGY

Implementing a dust cleaning robot involves several steps. Here's a basic methodology.

Define Requirements: Determine the scope and purpose of the robot. Identify the surfaces it will clean, the area it needs to cover, and any specific functionalities required.

Select Components: Choose appropriate hardware such as motors, sensors (like infrared or ultrasonic), a microcontroller (such as Arduino or Raspberry Pi), cleaning mechanisms (brushes, suction, etc.), and a power source (batteries or charging dock).

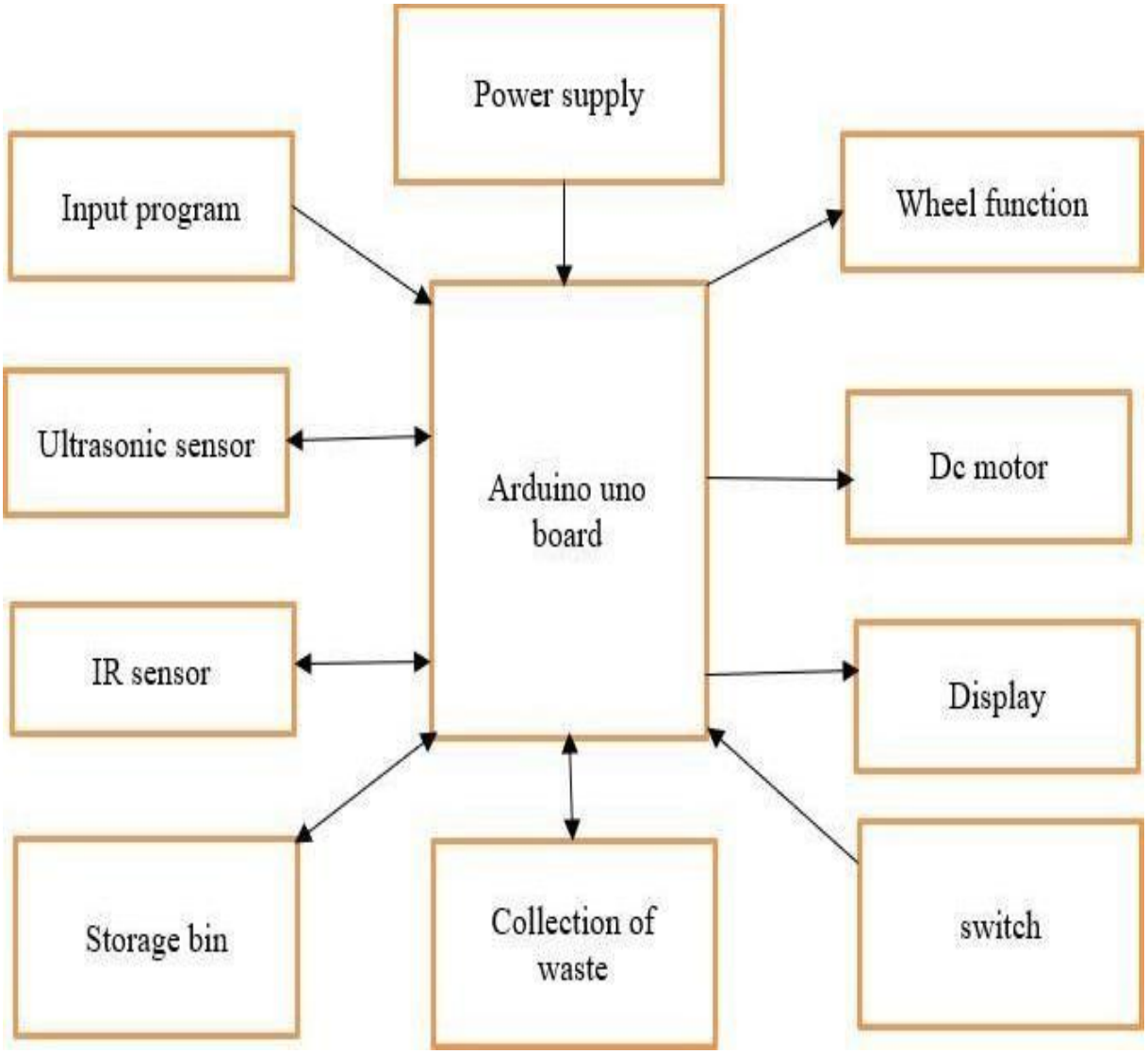
Design and Build: Create a prototype or a 3D model of the robot. Assemble the components, considering the mobility, cleaning mechanism, and overall structure. Ensure the robot's size allows it to maneuver easily in different spaces.

Coding and Programming: Write the necessary code to control the robot's movements, sensor readings, cleaning mechanisms, and any other functionalities. This may involve programming the microcontroller and integrating sensor feedback for navigation and obstacle avoidance.

Testing and Refinement: Test the robot in various environments to ensure it functions correctly. Refine the design, code, or hardware as needed based on test results.

Deployment and Maintenance: Once the robot is functioning properly, deploy it in the intended environment. Regularly maintain and update the robot to keep it efficient and effective in its cleaning tasks.

3.2 BLOCK DIAGRAM



BLOCK DIAGRAM

A dust cleaning robot's functionality is orchestrated through a complex yet streamlined system. Its architecture involves several pivotal components. Sensors, like infrared or ultrasonic detectors, play a crucial role by perceiving obstacles and identifying areas in need of cleaning. These sensor inputs are relayed to the controller, the robot's cognitive centre. The controller, often a microcontroller, processes this data and formulates decisions based on pre-programmed algorithms.

CHAPTER-4

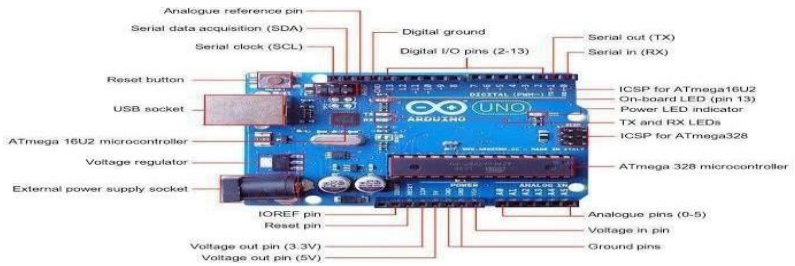
WORKING MODEL AND FLOW CHART

4.1 WORKING MODEL

LIST OF COMPONENTS USED

Creating a dust cleaning robot involves a meticulous process. It begins with comprehensive planning, selecting the right components, and constructing a suitable chassis that accommodates motors, wheels, sensors (such as IR sensors for obstacle detection), a microcontroller (like Arduino or Raspberry Pi), a dust collection mechanism, and a power source. The construction phase involves assembling the components onto the chassis, ensuring proper wiring and connections. Programming the microcontroller is crucial, enabling the robot to control its movements, respond to sensor input, and manage the cleaning process efficiently. Testing the robot's functionality in different scenarios helps refine its design, code, and components. Throughout the process, documentation of each step ensures a comprehensive understanding of the robot's development. Online resources and communities can provide valuable guidance and support, making the journey of building a dust cleaning robot both educational and rewarding.

ARDUINO UNO: The Arduino UNO board consists of fourteen digital input/output pins and six analog input pins. It can be programmed using Arduino IDE via a type B USB cable. Input voltage range of Arduino UNO lies between 7 to 20 volts but the operating voltage of Arduino UNO is 5V. The Clock speed of Arduino UNO is 16MHz. It has 32KB flash memory, 2KB SRAM and 1KB EEPROM



4.1.1 ARDUINO UNO

MOTOR DRIVER: IC is a Motor Driver IC which allows DC motor to drive on either direction. motor driver IC has 16 pins which are used to control a set of two DC motors simultaneously in any direction. It

is based on the concept of H-bridge. The direction of voltage or current flow will be decided by the H-bridge

4.1.2 MOTOR DRIVER

DC MOTOR: A dc motor is a motor whereby direct current electrical power is converted into mechanical power. Most often, this type of motor relies on forces that magnetic field produce. A 12v DC motor is small and inexpensive, yet powerful enough to used for many applications. Proposed robot is designed with four DC motors to operate in forward and backward directions

4.1.3 DC MOTOR

VACUUM COMPRESSORS: Vacuum compressor is a device used to remove gas molecules from the sealed volume in order to leave behind a partial vacuum.

BRUSHING MOTOR CONTROLLER: The circuit consists of two transistors. One transistor takes a signal from Arduino controller and drives another transistor. Transistor which takes a signal is BJT 2N2222 and other one is TIP-122. Circuit works on 12V DC supply connected through a switch and fuse. Two transistors are used because single TIP- 122 has high current rating and cannot be activated by Arduino directly. Transistor BJT 2N2222 is not used solely because stall current of brush motor is much high and BJT will not provide necessary current. So combination of these two gives a successful circuit to drive brush motor. **ULTRASONIC SENSORS:** in dust cleaning robots emit high-frequency sound waves and measure the time it takes for these waves to bounce back after hitting an object. By calculating this time delay, the sensor determines the distance to the object, helping the robot to avoid collisions or

navigate around obstacles while cleaning. his sensor is a high-performance ultrasonic range finder. It is compact and measures an amazingly wide range from 2cm to 4m. This ranger is a perfect for any robotic application, or any other projects requiring accurate ranging information. This sensor can be connected directly to the digital I/O lines of the microcontroller and distance can be measured in time required for travelling of sound signal using simple formula as below.

4.1.4 ULTRASONIC SENSOR

DUST SENSOR: is specially developed for dust removal equipment such as sweeping robots/vacuum cleaners. It solves the main technical problems of dust response speed, sewage identification, long-term dust accumulation and installation structure.

4.1.5 DUST SENSOR

A LIQUID-CRYSTAL DISPLAY (LCD): is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

4.1.6 LCD DISPLAY

POWER SUPPLY: The rechargeable battery option offers portability and autonomy, allowing the robot to move freely without being tethered to a power outlet. These batteries are usually lithium-ion or similar types that provide sufficient power for the robot to operate for a reasonable amount of time before needing a recharge.

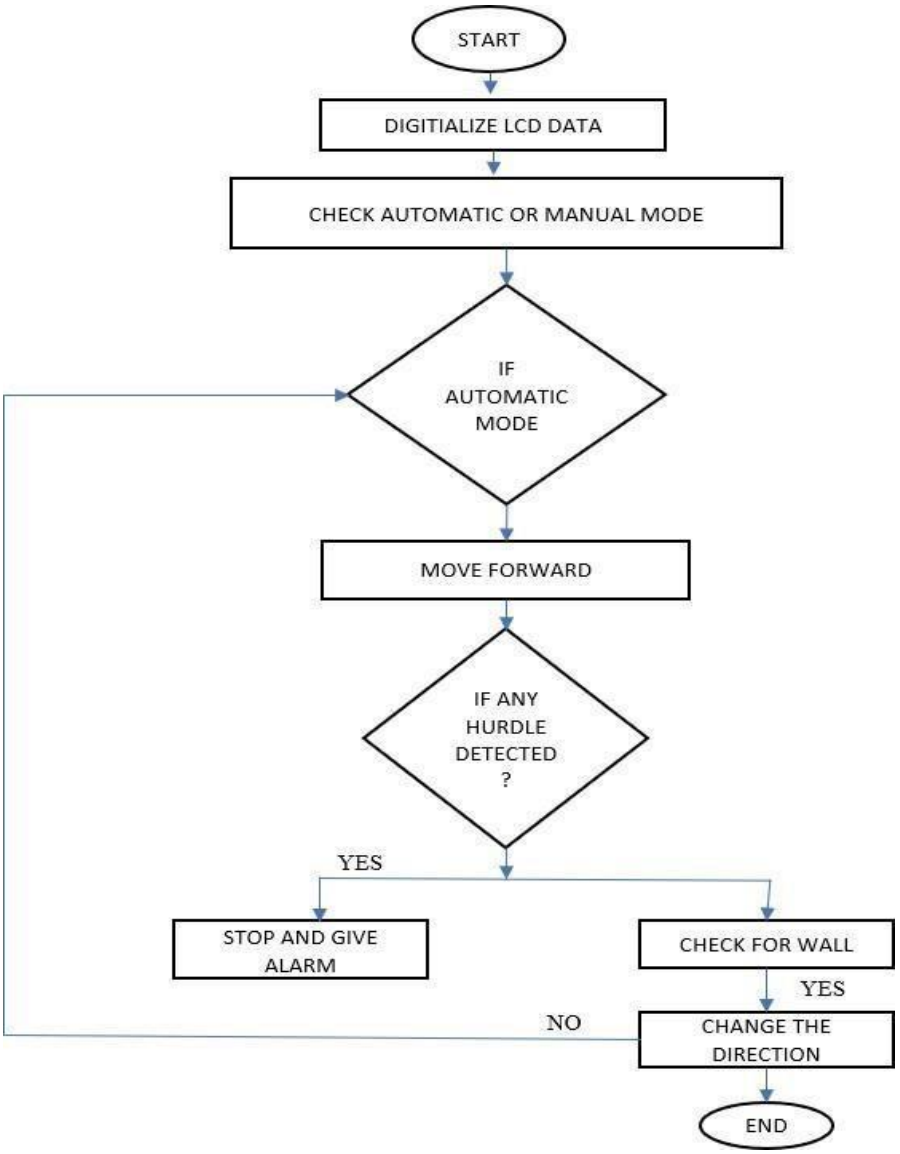
4.1.7 POWER SUPPLY

WHEEL FUNCTION: The wheel function in a dust cleaning robot typically controls the movement of the wheels. It might involve commands to move forward, backward, turn left, turn right, or stop the wheels altogether. The specific implementation depends on the robot's hardware and programming.

4.1.8 WHEEL FUNCTION

ARDUINO IDE: The software consists of a text editor, message area, text console, toolbar with buttons for common functions, and menu system. Once the written section is finished, it is uploaded to the Arduino.

4.2 FLOW HART



The flow chart for a dust cleaning robot encapsulates its operational sequence in a step-by-step depiction. Starting with the initialization phase, it checks all systems for readiness. Moving forward, the sensors scan the environment, detecting obstacles or dirty areas. Based on these sensor inputs, the robot's controller decides the next course of action, branching into two paths: one for obstacle avoidance and navigation, and another for identifying and addressing dirty spots.

CHAPTER-5

RESULT

- The implementation of a dust cleaning robot involves several key components and considerations to ensure optimal performance.
- These sensors can include infrared sensors for detecting walls and furniture, bump sensors for collision avoidance, and cliff sensors to prevent falls down stairs or ledges. Additionally, a dust sensor is essential for identifying areas with high dust concentration, guiding the robot to prioritize cleaning those spots.
- The cleaning mechanism typically consists of rotating brushes or rollers to loosen dirt and debris, followed by a vacuum system to suck up the loosened particles into a dustbin.
- Power management is crucial for ensuring the robot's autonomy and efficiency. This involves optimizing the battery capacity and implementing intelligent charging algorithms to prolong battery life and minimize downtime.
- In conclusion, the successful implementation of a dust cleaning robot requires careful consideration of physical design, sensor integration, cleaning mechanism, navigation techniques, power management, and user interface design to deliver effective and hassle-free cleaning solutions for both residential and commercial applications.

DISCUSSION

The floor cleaning process can be done in an easier manner and more efficiently by robot utilizing wireless robotic system. This proposed robot reduces the time and cost of labor. In the previous research papers like robot vacuum cleaner and automatic floor leaner, robot had some drawbacks like colliding with objects in front of it and this vacuum cleaner couldn't reach to small areas and left those areas unclean and the automatic floor cleaner robot collects the dust but the drawback overhere is that it cleans the wet floor.

ADVANTAGES

1. **Efficiency**: These robots are designed to efficiently clean dust from various surfaces without human intervention. They can cover large areas quickly and thoroughly, saving time and effort.
2. **Consistency**: Unlike humans, robots maintain a consistent level of cleaning performance. They don't get tired or distracted, ensuring that every area receives the same attention to detail.
3. **Accessibility**: Dust cleaning robots can reach areas that are difficult for humans to access, such as under furniture, behind appliances, and high ceilings. This ensures a more comprehensive cleaning job.
4. **Time-saving**: With their autonomous operation, these robots can clean while you focus on other tasks or even when you're not at home, saving you valuable time.
5. **Allergy relief**: Dust cleaning robots equipped with HEPA filters can effectively capture allergens like dust mites, pollen, and pet dander, helping to improve indoor air quality and providing relief for allergy sufferers.
6. **Smart features**: Many dust cleaning robots are equipped with smart features like scheduling, mapping, and app connectivity. This allows users to customize cleaning schedules, monitor cleaning progress remotely, and even control the robot using their smartphones or voice commands.
7. **Energy efficiency**: Most modern dust cleaning robots are designed to be energy-efficient, consuming less power compared to traditional vacuum cleaners.
8. **Cost-effective**: While the initial investment may be higher than traditional cleaning methods, dust cleaning robots can be cost-effective in the long run due to their efficiency and durability, reducing the need for manual labour and the frequency of professional cleaning services.

DISADVANTAGES

1. **Initial Cost**: Dust cleaning robots can have a higher upfront cost compared to traditional cleaning tools like brooms or vacuum cleaners. This initial investment might be a barrier for some users.
2. **Maintenance**: Like any mechanical device, dust cleaning robots require regular maintenance to ensure optimal performance. This includes cleaning brushes, emptying dust bins, replacing filters, and occasionally troubleshooting technical issues.
3. **Limited Capacity**: Most dust cleaning robots have a limited dust bin capacity, which means they may need to be emptied frequently, especially in larger or heavily trafficked areas. This can interrupt cleaning sessions and require more frequent user intervention.
4. **Navigation Challenges**: While many modern robots are equipped with advanced navigation systems, they may still encounter challenges navigating complex environments with obstacles like furniture, cords, or irregular surfaces. This can result in missed spots or the robot getting stuck.
5. **Noise**: Depending on the model, dust cleaning robots can generate noise during operation, which may be disruptive, particularly in quiet environments or when cleaning during sleeping hours.
6. **Limited Cleaning Abilities**: While effective for dusting and light debris, dust cleaning robots may struggle with heavier messes or deep cleaning tasks. They may not be able to remove stains, spills, or ingrained dirt as effectively as traditional cleaning methods.
7. **Dependency on Technology**: Dust cleaning robots rely heavily on technology, including sensors, motors, and software algorithms. Malfunctions or technical issues can disrupt their functionality and require professional repair or replacement.
8. **Security Concerns**: Some users may have concerns about the security and privacy implications of smart features like mapping and remote control. There's a risk of data breaches or unauthorized access to sensitive information if the robot's connectivity is compromised.

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