RFID CONTROLLED AUTOMATED PATH ROBOT

A PROJECT REPORT
Submitted by

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BONAFIDE CERTIFICATE

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DECLARATION

We hereby declare that the Major Project entitled “**RFID CONTROLLED AUTOMATED PATH ROBOT** ” to be submitted for the Degree of Bachelor of Technology is our original work as a team and the dissertation has not formed the basis of any degree, diploma, associateship or fellowship of similar other titles. It has not been submitted to any other University or institution for the award of any degree or diploma.

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ABSTRACT

A system intended to navigate independently within a predetermined environment is summarized in the abstract of an RFID-controlled automated path robot. In order to obtain the robot's motion planning path more quickly, RFID technology allows for precise control over a robotic system's movements. This integration allows the robot to operate autonomously through pre-planned routes or challenging terrain without requiring human assistance. By placing RFID tags strategically along a predetermined path, this system uses Radio Frequency Identification (RFID) technology to direct the robot. As waypoints, these tags give the robot directions and position information. Microcontrollers, usually small, powerful units like the NODEMCU ESP8266, are at the core of the robot's control system. They interpret the signals that come in from the RFID reader. When obstacles are detected by onboard sensors, the microcontroller uses a path-finding algorithm, like Dijkstra's Algorithm, to find the best route to reach the destination. The robot can move smoothly along the path thanks to a set of motors that power its wheels. A crucial feature that guarantees the robot can man ever around unforeseen obstacles without assistance from a human is obstacle avoidance, which is frequently accomplished by ultrasonic sensors. One could imagine a plethora of real-world uses for such a robot, from item delivery in expansive facilities to material handling in warehouses. A variety of industries looking to boost productivity and cut expenses can find the system to be a compelling option due to its scalability and flexibility.

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TABLE OF CONTENTS

ABSTRACT **4**

ACKNOWLEDGEMENT **5**

LIST OF TABLES **vi**

ABBREVIATIONS **viii**

1 INTRODUCTION 1

1.1 Industry 4.0. 1

1.2 Brief Description of Project 1

1.3 Problem statement... 2

1.4 Literature survey …………………………………………………..3

1.4.1 RFID automatic labeler for item level 3

1.4.2 Research on path planning for robot based on improved design of non-standard environment map with any colony alogorithm 3

1.4.3 RFID Adapative in healthcare Organizations an integrative framework 3

1.4.4 IOT Sensing applications and challenges using RFID and wireless Sensor networks…………………………………………4

1.4.5 A novel dynamic Path re-planning algorithm with heading constraints For human robots .... …….4

2 METHODOLOGY ………………………………………………………..5

2.1 EXISTING SYSTEM 5

2.1.1 Conventional apartments security systems 5

2.1.2 Disadvantages 6

2.2 PROPOSED SYSTEM 6
2.2.1 Regulated patrolling robot for apartments 6
2.3 Technologies Used in Proposed system 7
2.4 Block Diagram……………………………………………………...9
2.5 Block Diagram Explanation……………………………………...9
3 IMPLEMENTATION 13
3.1 Hardware Requirements 10
3.1.1 NodeMCU 10
3.1.2 RFID Reader and tag 17
3.1.3 DC Motor 21
3.1.4 Battery 24
3.2 Software Requirements 10
3.2.1 ARDUINO Software(IDE) 25

4 CONCLUSION AND FUTURE ENHANCEMENT 40
4.1 Conclusion 40
4.2 Future Work 41
4.3 Result 43
4.4 References 44

I) Annexure 45

LIST OF FIGURES

Figure 2.1 block diagram OF RFID Controlled automated path robot..9
Figure 3.1. NODEMCU Microcontroller...10
Figure 3.2. NODE ESP8266……………...12
Figure 3.3. RFID Reader and tag.. 17
Figure 3.4. Coils in rfid tags and reader……….. 19
Figure 3.5. sender and receiver RFID signal..20
Figure 3.6. Signals receiver for rfid …...20
Figure 3.7. DC motor………………….. 21
Figure 3.8. Back EMF…………………...23
Figure 3.9. 9V Battery…………………………………………………………………………25
Figure 3.10. Arduino IDE………………...25
Figure 4.1. prototype of RFID controlled automated path robot…...39
Figure 4.2. Software result…………...40

ABBREVATIONS

1. RFID: Radio frequency identification
2. AI: Artificial intelligence
3. IoT: Internet of Things
4. WSN: Wireless Sensor Network
5. HFR: Human Following Robot
6. GPIO: General Purpose Input/Output
7. LiDAR: Light Detection and Ranging
8. API: Application Programming Interface
9. IC: Integrated circuit
10. RAM: Random Access Memory
11. Wi-Fi: Wireless Fidelity
12. GND: Ground
13. USB: Universal Serial Bus
14. UART: Universal Asynchronous Receiver-Transmitter
15. PWM: Pulse Width Modulation
16. SPI: Serial Peripheral Interface
17. I2C: Inter-Integrated Circuit
18. I2S: Inter-IC Sound
19. ADC: Analog-to-Digital Converter

CHAPTER 1

INTRODUCTION

1.1 Industry 4.0

Industry 4.0, known as the fourth industrial revolution, represents a significant shift in the manufacturing sector through the incorporation of advanced technologies like the Internet of Things (IoT), cyber-physical systems, big data analysis, and artificial intelligence (AI) to develop intelligent factories. In this setting, RFID (Radio Frequency Identification) plays a critical role in streamlining and enhancing manufacturing procedures. RFID technology utilizes electromagnetic fields for the automatic identification and tracking of tags attached to various objects. In the context of an RFID-controlled automated path robot, these tags play a crucial role in guiding and supervising the robot's movements within an industrial setting. By reading RFID tags positioned along its path, the robot can determine its precise location and decide on its course of action. This technology proves especially beneficial in tasks such as material handling, where the robot can transport goods from one point to another with minimal human involvement. The amalgamation of RFID technology with automated path robots significantly amplifies the efficacy of production lines by offering precise control over the movement of goods. It also aids in reducing errors and accelerating operational speeds. The information gathered by RFID scanners can be utilized for real-time tracking, managing inventory, and even predicting maintenance needs, ensuring that the robots perform optimally while preemptively addressing any potential issues before they lead to operational downtime

1.2 Brief Description of Project

A project involving an automated path robot controlled by RFID technology focuses on developing a robotic system capable of independently navigating and completing tasks within a set environment. The heart of this system lies in RFID technology, using radio waves to interact with small electronic tags that can be affixed to or integrated into objects and materials. Equipped with an RFID reader, the robot scans for these tags to establish its position and determine navigation routes. As it progresses along its designated path, it reads the unique identification of each RFID tag strategically positioned throughout the facility. This data is utilized to steer the robot towards its destination, whether for moving materials between locations or executing specific actions at designated spots. The primary goal of this project is to enhance operational efficiency by reducing the dependency on manual intervention in goods transportation. Additionally, it aims to decrease errors linked to human handling and accelerate the movement of items within manufacturing or warehouse settings. This RFID-controlled robot stands as a significant advancement towards the future of automated industries. In this future, machines can communicate and function with substantial intelligence and autonomy, embodying the fundamental principles of Industry 4.0.

1.3 PROBLEM STATEMENT

- **Manual Path Guidance Limitations:** Current robotic systems often rely on manual programming or external guidance systems for path navigation, a process that is tedious, error-prone, and lacks adaptability. Consequently, they struggle to meet evolving operational requirements and navigate dynamic environments effectively.

- **Precision and Efficiency Challenges:** In tasks such as manufacturing or logistics operations that demand precise and efficient path tracking, conventional navigation methods may fall short in delivering the required accuracy and effectiveness. This shortfall could lead to inefficiencies, delays, and errors while executing tasks.
- **Complex Terrain Navigation:** Navigating complex terrain or preset paths without human intervention remains a significant obstacle for current robotic systems. Conventional navigation techniques may struggle to adapt to evolving environmental circumstances or moving obstacles encountered along the programmed route.
- **Real-time Decision-making:** Robotic systems often face challenges in makingreal -time decisions based on their surroundings and navigation requirements. Adapting their movements without consistent feedback and guidance can be a struggle for robots, leading to suboptimal path tracking and potential safety hazards.
- **Scalability and Adaptability:** Robotic navigation systems must possess scalability and flexibility, particularly in environments prone to frequent layout and requirement changes. Should alterations in path layouts or operational conditions occur, existing solutions may struggle to adjust without significant reprogramming or reconfiguration efforts.

1.4 Literature Survey

1.4.1 RFID automatic labeler for Item level

1.4.

2 Alessandro Luz (2023) introduces a machine designed to identify all manufactured items within the production line, aiming to optimize the management process by preventing errors, enhancing product adaptability, and streamlining the goods' movement in the warehouse. The proposed autonomous mobile vehicle incorporates a simple and cost-effective motor. However, challenges arise due to the intricate and costly material and capability requirements of RFID technology."

1.4.3 Research on Path Planning for Robot Based on Improved Design of NonStandard Environment Map With Ant Colony Algorithm.

FENG LI. (2023) Grid maps are commonly utilized for guiding mobile robots along specific paths, created either through manual design or sensor data capture for subsequent modeling. To enhance the efficiency of robot motion planning, this study suggests employing the ant colony algorithm in mapping out robot motion paths within unconventional environmental settings. One notable limitation identified relates to the restricted operational range of RFID technology

1.4.4 RFID Adaption in Healthcare Organizations: An Integrative Framework

Ahed Abugabah. (2021) introduces a sophisticated technology that operates without physical contact to identify specific objects and gather essential information and key attributes through radio frequency signals. Managing information related to medical equipment plays a crucial role in a modern hospital environment, directly impacting the accuracy of diagnoses, quality of care provided, and overall advancements and prosperity of the hospital.

1.4.5 IoT Sensing Applications and Challenges Using RFID and Wireless Sensor Networks.

Hugo Landaluce. (2020) RFID systems have the capability to recognize and monitor devices, while WSNs collaborate to collect and furnish data from interconnected sensors. An obstacle arises in converting RFID systems, initially focused on identification, into platforms that incorporate sensing and computational functions, as well as regarding them as configurations of wirelessly connected sensing tags. The advantages lie in the ability of the systems to recognize and track devices, alongside the cooperation of WSNs in collecting and providing information from interconnected sensors. However, the drawback is their limitation in high-speed communication, tailored for low-speed applications. Additionally, the efficiency of energy harvesting remains a notable consideration.

1.4.6 A Novel Dynamic Path Re-Planning Algorithm With Heading Constraintsfor Human Following Robots

Summarize the foundational concepts and methodologies proposed by Hui Zhang (2020) emphasizes the importance of real-time path adjustments for Human Following Robots (HFRs) based on changing obstacles and target locations to ensure safe and efficient operation. While traditional path planning algorithms primarily address obstacle avoidance and effective target connection, there is a lack of research on reducing robot heading fluctuations resulting from path re-planning. The expense associated with implementing re-planning algorithms is noted as a significant limitation in addressing this issue.

CHAPTER 2
METHODOLOGY

2.1 Existing System

The current automated navigation system for robots previously relied on traditional techniques such as preset paths, proximity sensors, and computer vision. These approaches had limitations in terms of adaptability and real-time adjustments.

2.1.1 Conventional Automated robot Systems:

Pre-Programmed Routes:

- Essential pre-programmed routes are necessary for automated path robots to efficiently and effectively carry out their tasks.

- Path planning plays a crucial role in the realm robotics, particularly for self-navigating mobile robots that require efficient navigation within their surroundings.
- There exist various categories of path planning algorithms, such as graph-based exploration, heuristic reasoning, local obstruction avoidance and also artificial intelligence.
- These algorithms operate by taking into account the current position of the robot and the desired destination, then determining the most effective path to reach it.

Computer Vision:

- Computer vision enables navigation, object and obstacle recognition, and decision-making based on visual inputs. By acting as the robot's eyes, the cameras capture images for analysis through advanced algorithms to comprehend the surrounding environment.
- A robot could utilize computer vision to recognize the boundaries of a path, detect markings or signs, and adhere to a predetermined route. Furthermore, it has the capability to handle more intricate tasks such as navigating around obstacles.
- The incorporation of computer vision technology into autonomous robots greatly improves their independent decision-making abilities and adaptability.
- The development of machine learning and neural networks has further enhanced the capabilities of computer vision systems, leading to improved accuracy and faster processing of visual data.

2.1.2 Disadvantages:

1. Limited adaptability.
2. Lack of Precision. 3. Environment dependency.

2.2 PROPOSED SYSTEM:

- The proposed project system incorporates RFID readers strategically positioned along specific routes. RFID tags placed within the robot interact with these readers, facilitating instant data exchange for accurate guidance.
- The system enables the robot to make real-time adjustments to its path by recognizing RFID tags, ensuring precise following of predetermined routes. Utilizing RFID technology allows for detailed control, improving the robot's flexibility in intricate surroundings.

2.2.1 Regulated RFID controlled automated path robot:

2.2.1.1 RFID Technology integration:

- **Definition:** RFID, (radio frequency identification), utilizes electromagnetic or electrostatic coupling in the radio frequency segment of the electromagnetic spectrum to distinguish objects.

- **Functionality:** In automated path robot, the rfid technology serve the RFID reader and tag as primary microchip to antennas.

Features:

- **Unique ID:** RFID offers a method to accurately distinguish individual components, groups of materials, construction machinery, retail products, or other items.

- **Automatic Recognition:** Readers receive the stored ID from RFID tags attached to items.
- **Reading Multiple Tags:** reading multiple tags simultaneously. RFID technology enables the simultaneous reading of multiple tags within its range, effectively enhancing efficiency in inventory management and tracking processes.

Advantages:

- **Improved Inventory Management and Accuracy:** Utilizing real-time tracking enables the swift and precise identification of items within warehouses and throughout the supply chain.
- **Asset Tracking:** Efficiently tracks the movement of raw materials and components within facilities, minimizing the necessity to reorder misplaced parts. • **Speed and Convenience:** Readers do not require objects to be in their direct line of sight.

2.2.1.2 Robot Navigation System:

- **Definition:** Combining RFID scans with results from object identification, the system alters paths in real-time to circumvent obstacles.
- **Functionality:** In, RFID controlled automated path robot, Robot navigation systems are essential for facilitating the movement of autonomous robots within their surroundings in a safe and efficient manner.

Features:

- **Self-localization:** The concept of self-localization pertains to the robot's capacity to ascertain its precise position and orientation within its established reference framework.
- **Path Planning:** Determining the most efficient route from the current position of the robot to a specified destination is essential.
- **Map building:** Creating representations of the surrounding environment involves the development of metric maps or alternative notations that are specific to the frame of reference of the robot.

Advantages:

- **Efficient Navigation:** Robots have the ability to effortlessly maneuver through intricate settings, thus decreasing the time needed to accomplish tasks.
- **Accurate Self-Localization:** A strong navigation system enables the robot to accurately determine its own position and orientation.

2.3 TECHNOLOGIES USED IN PROPOSED SYSTEM

- **RFID (Radio-Frequency Identification) Technology**: An essential component of the project is RFID technology, which allows for communication between RFID tags embedded in the robot and RFID readers placed strategically along predetermined paths. This enables real-time guidance and movement control for the robot.
- **RFID Readers**: RFID readers are positioned along pre-established routes, detecting and interacting with RFID tags embedded in the robot. They are essential in helping the robot navigate by giving it exact location data and direction..
- **RFID Tags**: RFID tags are integrated into the robot to enable communication with RFID readers and store unique identifying information. They allow the robot to locate itself and receive commands for precisely following predetermined routes..
- **Microcontrollers**: used as a bridge between the robotic system's control unit and RFID readers and tags. Microcontrollers receive and process RFID data, decipher commands, and then program the robot's movements accordingly.
- **Sensors**: The robotic system may incorporate extra sensors in addition to RFID-based navigation. LiDAR (Light Detection and Ranging) sensors and ultrasonic sensors, for example, can detect obstacles and offer more environmental awareness.

2.4 BLOCK DIAGRAM:

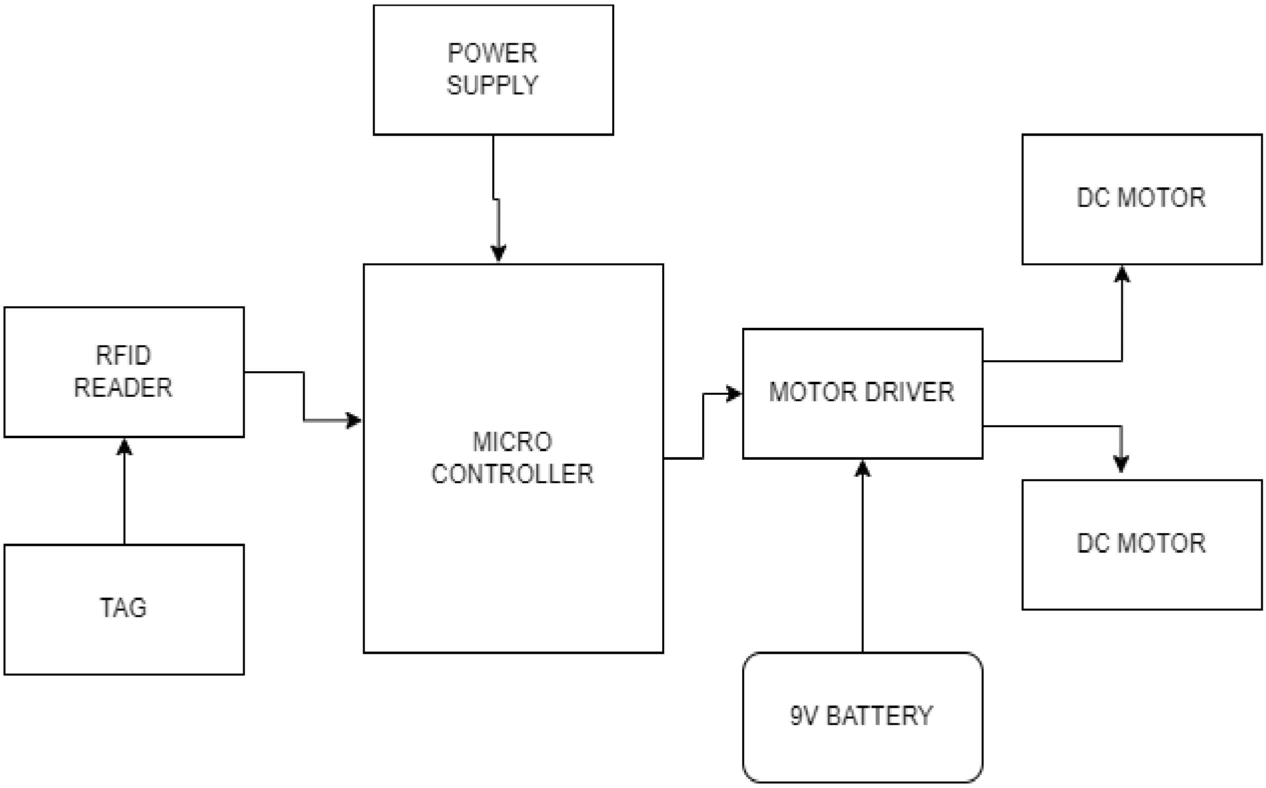

FIG 2.1 block diagram OF RFID Controlled automated path robot

2.5 BLOCK DIAGRAM EXPLAINATION:

The envisioned system comprises a network of interlinked elements that collaborate to heighten security within the apartment complex. The design of the Automated Path Robot, managed through RFID technology, incorporates several vital components connected to enable autonomous movement. The central processing unit, also known as the microcontroller, serves as the core processing unit. By utilizing the RFID Reader & Tag setup, the robot can interact with predetermined paths marked with RFID tags. With guidance from the Motor Driver, the robot travels along these designated pathways, ensuring its maneuverability and autonomy. Fueled by a 9V battery and overseeing the DC motors, this robotic setup works harmoniously, enabling the robot to navigate predefined routes with accuracy and effectiveness, showcasing the capabilities of RFID technology in the realm of robotics.

When in operation, the robot utilizes an RFID reader to identify tags positioned along its path or on objects The Arduino then processes this data to guide the robot towards specific locations or engage with tagged objects. Through the Bluetooth module, the robot can be controlled remotely or receive programming updates, while the robotic arm allows it to complete tasks like picking up and moving items. This setup is commonly found in systems such as library management, where a robot may navigate through aisles to find and retrieve books using RFID tags, or in industrial environments for handling and sorting materials. The selection of components and their arrangement can vary based on the unique needs of the application and the robot's design.

CHAPTER 3 IMPLEMENTATION

3.1 HARDWARE REQUIREMENTS

- Microcontroller
- RFID Reader & Tag
- Motor driver
- Dc motor
- 9V Battery

3.2 SOFTWARE REQUIREMENTS

- Arduino ide
- Embedded c

3.1. HARDWARE MODULES

3.1.1. NODE MCU:

General-purpose input/output (GPIO) refers to a pin found on an Integrated Circuit (IC) that can function as either an input or an output. Its behavior can be dynamically controlled during runtime, allowing for versatile usage in various electronic applications

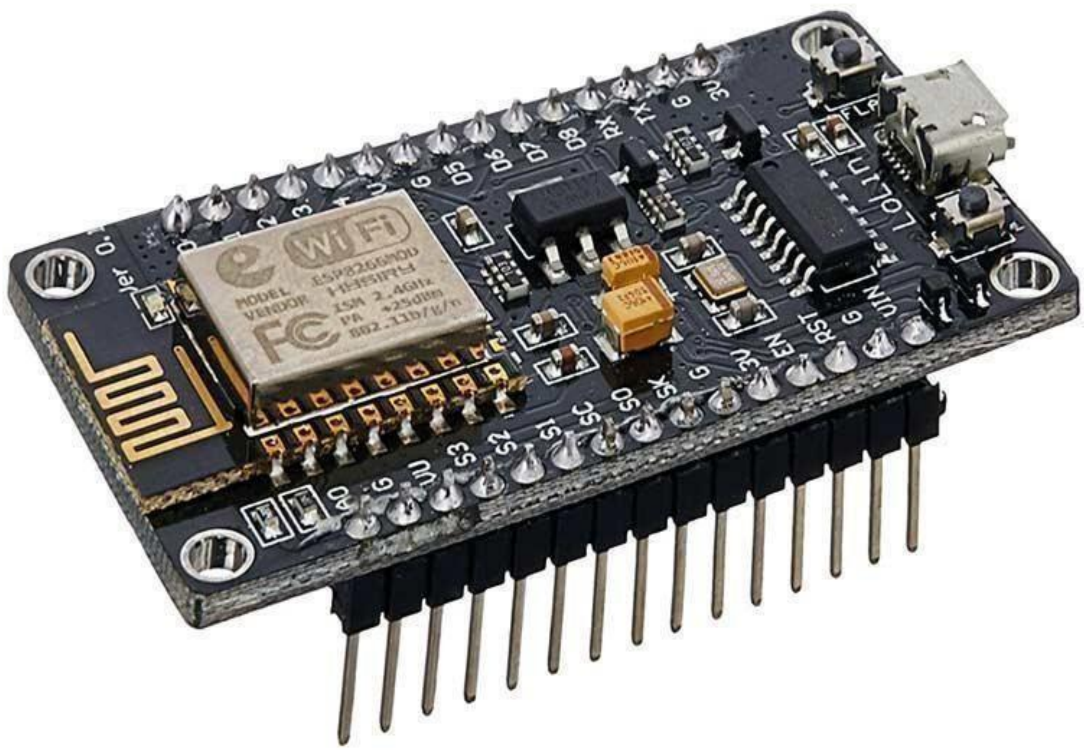

FIG 3.1. NODEMCU Microcontroller

The NodeMCU firmware and development board utilize the Lua programming to cater to applications within Internet of Things sphere. Its core hardware is based on the ESP-12 module, with the firmware operating on the ESP8266 Wi-Fi SoC engineered by Espressif Systems.

NodeMCU Development Board Pinout Configuration:

Pin Category	**Name**	**Description**
Power	Micro-USB, 3.3V, GND, Vin	**Micro-USB:** NodeMCU can be powered through the USB port

		3.3V: Regulated 3.3V can be supplied to this pin to power the board **GND:** Ground pins **Vin:** External Power Supply
Control Pins	**EN, RST**	The pin and the button resets the microcontroller
Analog Pin	A0	Used to measure analog voltage in the range of 0-3.3V
GPIO Pins	GPIO1 to GPIO16	NodeMCU has 16 general purpose input-output pins on its board
SPI Pins	SD1, CMD, SD0, CLK	NodeMCU has four pins available for SPI communication.
UART Pins	TXD0, RXD0, TXD2, RXD2	NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program.
I2C Pins		NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C.

NodeMCU ESP8266 Specifications & Features**:**

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V

- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT project

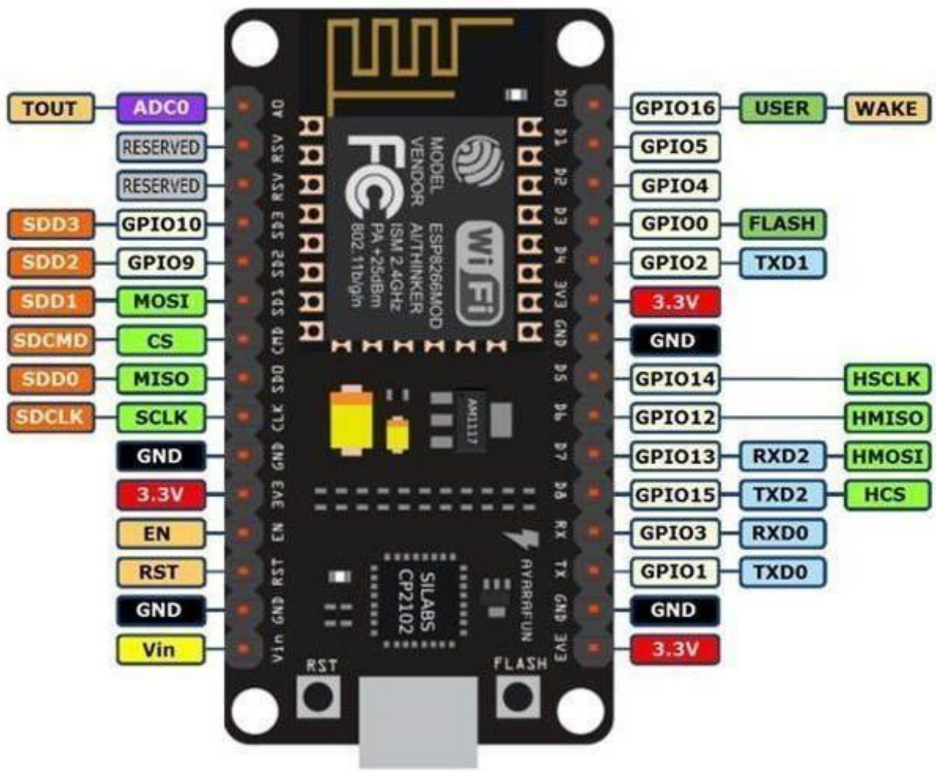

FIG 3.2. Node ESP8266

General Purpose Input/Output Interface (GPIO):

The ESP8266EX features 17 GPIO pins that can be programmed for various functions using the appropriate registers. Each GPIO can be set to internal pull-up, pull-down, or high. When configured as an input, the data is stored in software registers, with the option to set inputs as edge-trigger or level-trigger CPU interrupts. The IO pads are bidirectional, non-inverting, and tristate, including input and output buffers with tristate control inputs. These pins can be multiplexed with functions like I2C, I2S, UART, PWM, and IR Remote Control.

Secure Digital Input/Output Interface (SDIO)

ESP8266EX comes with a single Slave SDIO, with further details outlined below. It supports 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0.

Table 1-1: Pin Definitions of SDIOs

Pin Name	Pin Num	IO	Function Name
SDIO_CLK	21	IO6	SDIO_CLK
SDIO_DATA0	22	IO7	SDIO_DATA0
SDIO_DATA1	23	IO8	SDIO_DATA1
SDIO_DATA_2	18	IO9	SDIO_DATA_2
SDIO_DATA_3	19	IO10	SDIO_DATA_3
SDIO_CMD	20	IO11	SDIO_CMD

Serial Peripheral Interface (SPI/HSPI)

ESP8266EX has 3 SPIs.

One general Slave/Master SPI

One Slave SDIO/SPI

One general Slave/Master HSPI

Functions of all these pins can be implemented via hardware. The pin definitions are described as below.

Table 1-2. Pin Definitions of SPIs

Pin Name	Pin Num	IO	Function Name
SDIO_CLK	21	IO6	SPICLK
SDIO_DATA0	22	IO7	SPIQ/MISO
SDIO_DATA1	23	IO8	SPID/MOSI
SDIO_DATA_2	18	IO9	SPIHD
SDIO_DATA_3	19	IO10	SPIWP
U0TXD	26	IO1	SPICS1
GPIO0	15	IO0	SPICS2

Note:
SPI mode can be implemented via software programming. The clock frequency is 80 MHz at maximum.

General SPI (Master/Slave)

I2C Interface

The ESP8266EX contains an I2C interface that is utilized for connecting with a microcontroller and various peripheral devices like sensors. The pin configuration for the I2C

Table 1-4. Pin Definitions of I2C

Pin Name	Pin Num	IO	Function Name
MTMS	9	IO14	I2C_SCL
GPIO2	14	IO2	I2C_SDA

connection is outlined below.

Both I2C Master and I2C Slave are fully compatible. The functionality of the I2C interface can be achieved through software programming, with a maximum clock frequency of 100 kHz. It is important to ensure that the I2C clock frequency is faster than the slowest clock frequency of the slave device.

Universal Asynchronous Receiver Transmitter (UART)

ESP8266EX has two UART interfaces UART0 and UART, the definitions are as below

Table 1-6. Pin Definitions of UART

Pin Type	Pin Name	Pin Num	IO	Function Name
UART0	U0RXD	25	IO3	U0RXD
	U0TXD	26	IO1	U0TXD
	MTDO	13	IO15	U0RTS
	MTCK	12	IO13	U0CTS
UART1	GPIO2	14	IO2	U1TXD
	SD_D1	23	IO8	U1RXD

Data transfers between UART interfaces can be achieved through hardware. The data transmission speed through UART interfaces can reach up to 4.5 Mbps (115200 x 40). UART0 facilitates communication and supports flow control. On the other hand, UART1 is mainly utilized for printing logs as it only transmits data signals (Tx).

Pulse-Width Modulation (PWM)

The ESP8266EX includes four PWM output interfaces that users can expand on their own. The boundary definitions of the PWM interfaces are specified as follows.

Table 1-7. Pin Definitions of PWM

Pin Name	Pin Num	IO	Function Name
MTDI	10	IO12	PWM0
MTDO	13	IO15	PWM1
MTMS	9	IO14	PWM2
GPIO4	16	IO4	PWM3

The operational features of PWM interfaces can be enacted through software coding. For instance, in the LED smart light demonstration, the PWM function is accomplished by interrupting the timer, achieving a minimum resolution of 44 nanoseconds. The frequency range of PWM can be adjusted from 1000 microseconds to 10000 microseconds, equivalent to a range of 100Hz to 1 kHz. At a frequency of 1 kHz, the duty cycle will be 1 out of 22727, resulting in a resolution exceeding 14 bits at a refresh rate of 1 kHz..

Functional Overview

The ESP8266 protocol utilizes SDIO mode to establish communication with other processors' SPI hosts. The connection is made through signal line No.4, encompassing SCLK, MOSI, MISO, and interrupt signal No.1 in the SPI protocol. Unlike other programs, downloading the ESP8266 SDIO requires a distinct process. Upon startup, the ESP8266 defaults to reading the shared pin between SPI and SDIO interfaces, necessitating the use of the SDIO module communication protocol. The ESP8266 initiates in SDIO mode, allowing the host to activate the chip in the ESP8266 RAM via the downloaded SDIO programs. Most programs that directly access FLASH using CPU CACHE can be stored in the FLASH chip linked to the HSPI interface in advance.. Data received or sent by the ESP8266 SDIO is processed directly by the DMA module that supports linked list index. The ESP8266 efficiently handles the reception and transmission of SDIO packets independently of the CPU. This process is achieved by utilizing the memory map linked list addresses and re-transferring the sketch before connecting external voltage to AREF.

SOFTWARE TIPS

When loading a Atmega8 chip with Arduino 0010, an "– i800" command can delay the bootloader for 10 minutes. If you need to use the bootloader, it's recommended to use the command line instead of the IDE. Simply remove the "- i800" command and add the "-F" command, or utilize the Arduino 0007 IDE. The transfer process works smoothly when using Arduino 0010.

ARDUINO S3v3 NEW FEATURES

- full viable with Shield Boards (Version 2 is the main Arduino Board not viable with Shield Boards as a result of ICSP header wrong position, and tall parts);
- AVcc LP channel to lessen commotion level on ADC;
- auto reset include;
- auto reset empower/impair jumper, to dodge not wanted reseting;
- arduinoDiecimila viable reset pin;
- pin13 locally available drove, with current limiter resistor;
- TX and RX locally available leds;
- power drove with suitable current limiter resistor (less 20mA of comsumption);
- jumper to impair sequential correspondence and to empower RX outer draw down resistor, to evade "RX skimming blunder". This element permits to utilize computerized pin0 and pin1 as an ordinary pin, when sequential correspondence isn't required;
- all comparative segments (diodes, semiconductors, leds, capacitors) has a similar board direction (to commits simpler to mount with less errors);
- no wires between cushions, more space between wires, bigger wires, bigger cushions (better for drawing, binding and penetrating, with no shortcircuits, patching extensions or open wires in erosion);
- just 3 wire spans;
- electrolitic capacitor (in sequential to TTL circuit) changed to bipolar sort (to keep away from rearranged voltage issue when sequential link isn't associated);

All jumpers are correct point type, to permit Shield Boards use.

3.1.3 RFID (radio frequency identification reader)

An RFID reader is a tool utilized to collect data from an RFID tag, enabling the tracking of individual items. RFID functions similarly to bar codes, yet the RFID tag isn't required to be scanned directly or within the line of sight of a reader.

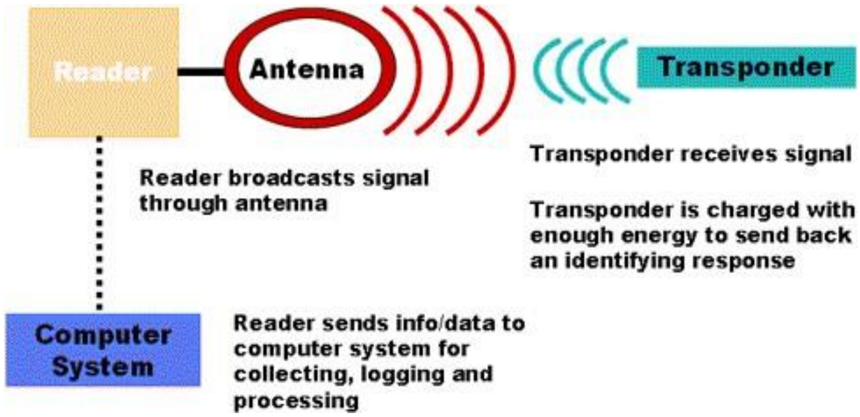

Fig 3.3 RFID reader and tag

- RFID technology functions similarly to barcodes, but with distinct advantages. Unlike barcodes, RFID tags do not need direct scanning or line-of-sight with a reader. Instead, they simply need to be within a range of 3 to 300 feet of an RFID to be detected. This technology allows for efficient scanning of multiple items and facilitates rapid identification of specific products, even within a crowded array of items..
- RFID tags have not replaced bar codes because of their cost and the need to individually identify every item.
- RFID, which stands for Radio Frequency Identification System, is technology-driven method of identifying objects. This system operates by utilizing tags attached to objects, enabling identification without the need for direct visual contact between the tags and the tag reader. The only requirement for functionality is radio communication between the tag and the reader.

A RFID tag:

A silicon microchip combined with a small antenna is affixed to a substrate and enclosed in materials such as plastic or glass fabric. It also features an adhesive on the rear side for attachment to objects.

- **A reader:** It consists of a scanner with antennas to transmit and receive signals and is responsible for communication with the tag and receives the information from the tag.

- **A Processor or a Controller**: It can be a host computer with a Microprocessor or a microcontroller which receives the reader input and process the data.

Types of RFID Systems:

- **Active RFID system:**

  These systems operate with an independent power source, such as an external power supply unit or a battery, with the limitation the lifespan of the power devices. They are suitable for long distances and monitoring valuable assets like vehicles.

- **Passive RFID system:**

  These are systems where the tag gets power through the transfer of power from a reader antenna to the tag antenna. They are used for short range transmission

How the Passive RFID System Works:

The tag can be powered either using inducting coupling method or through EM wave capture method. Lets us have a brief knowledge about the system using these two methods:

- Faraday's law of electromagnetic induction states that electromagnetic force (EMF) induces a current within a coil, resulting in the generation of a magnetic field surrounding it. As dictated by Lenz's law, the magnetic field produced by the coil opposes the magnetic field of the reader, leading to an amplified current flow in the reader's coil. The reader detects this interaction as the transmitted information, making this communication system ideally suited for short distances. The alternating current (AC) voltage across the coil is then transformed into direct current (DC) by utilizing rectification and filtration techniques.

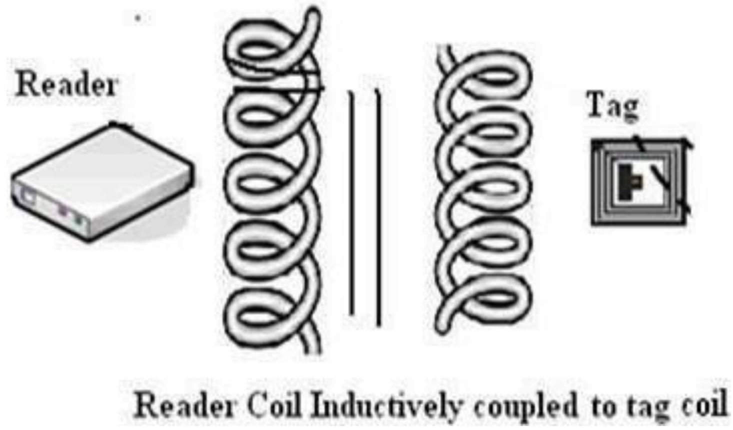

FIG3.4 coils in rfid tags and reader

A Passive RFID system using EM wave propagation method:

The reader's antenna emits electromagnetic waves, which the tag's antenna picks up as a potential difference across its dipole. This voltage is converted to DC power after being rectified and filtered. By setting the receiver antenna to different impedance levels, it reflects a portion of the incoming signal. The reader then receives and monitors this reflected signal accordingly.

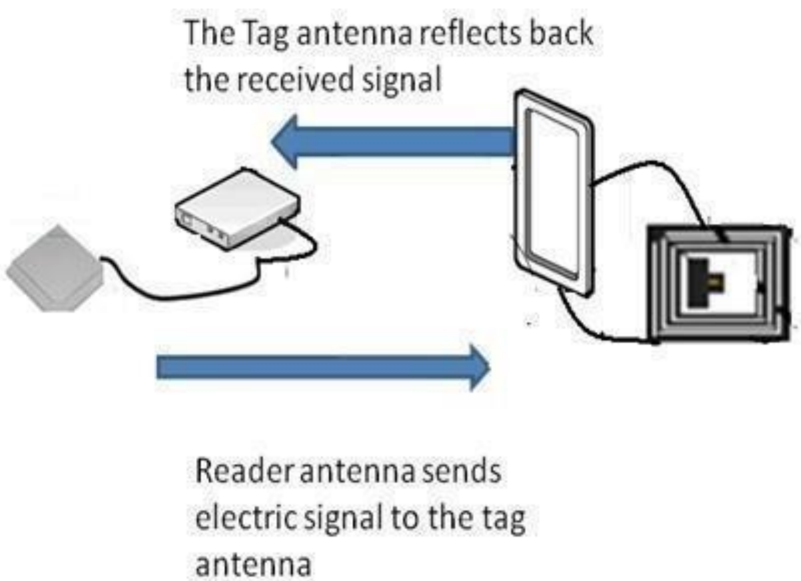

FIG 3.5. sender and receiver rfid signals

Active RFID System Works:

The reader in the active RFID system transmits a signal to the tag through an antenna. Once received, the tag retransmits the signal along with the stored information to the reader, which then forwards it to the processor for additional processing.

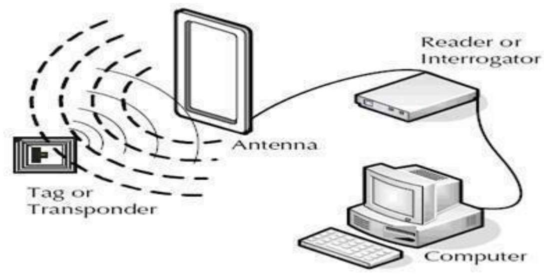

FIG 3.6. Receving process of RFID reader and tag

Application

- Passports
- Smart cards
- Airplane luggage
- Toll booth passes
- Home appliances
- Merchandise tags
- Animal and pet tags
- Automobile key-and-lock
- Monitoring heart patients
- Pallet tracking for inventory
- Telephone and computer networks
- Operation of spacecraft and satellites

3.1.3DC Motor

A machine that converts DC electrical power into mechanical power is known as a Direct Current motor. DC motor working is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force.

FIG 3.7. DC motor

Working principle of a DC motor

An electric motor is an electrical machine which converts electrical energy into mechanical energy. The basic working principle of a DC motor is: "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left-hand rule and its magnitude is given by F = BIL. Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.

Fleming's left hand rule:

If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other, and the direction of magnetic field is represented by the first finger, direction of the current is represented by the second finger, then the thumb represents direction of the force experienced by the current carrying conductor.

When armature windings are connected to a DC supply, an electric current sets up in the winding. Magnetic field may be provided by field winding (electromagnetism) or by using permanent magnets. In this case, current carrying armature conductors experience a force due to the magnetic field, according to the principle stated above.

Commutator is made segmented to achieve unidirectional torque. Otherwise, the direction of force would have reversed every time when the direction of movement of conductor is reversed in the magnetic field.

Back EMF:

The essential principle of nature states that energy conversion can only occur when there is resistance to the conversion process. Generators rely on magnetic drag to provide this resistance, whereas in the case of DC motors, it is the back electromotive force (emf) that serves this purpose. When the rotor of an electric motor is in, the wire loops within it also intersect with the magnetic field lines, causing an electromagnetic force based on Faraday's law of electromagnetic induction. This induced electromagnetic force acts in opposition to the current flowing through the rotor. The relationship between the back electromagnetic force and the rotor current direction is clearly shown in the circuit diagram below. The formula for calculating the magnitude of the back electromagnetic force is derived from the equation for the electromotive force of a direct current generator.

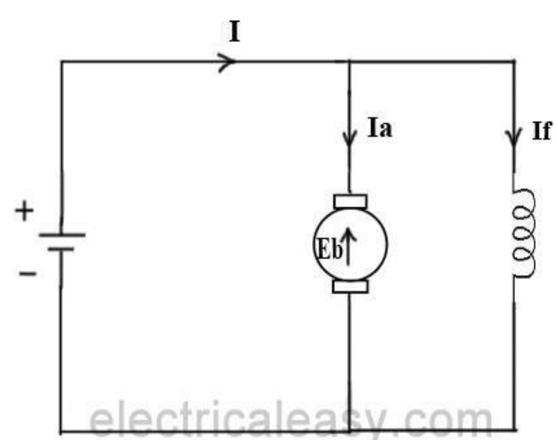

FIG 3.8 back emf

Significance of back emf:

The strength of the counter electromotive force (back EMF) is directly related to the speed of the motor. Let's imagine reducing the load suddenly on a DC motor. As a result, the necessary torque will decrease compared to the initial torque. The motor's speed will start to rise due to the surplus torque. Consequently, as the speed increases, the back EMF strength will also rise correspondingly. As the back EMF increases, the armature current will begin to decrease. Since torque is tied to the armature current, it will also diminish until it matches the load requirements. Therefore, the motor's speed will stabilize as a result.

If a dc motor experiences a sudden increase in load, it will result in a decrease in speed. This decrease in speed leads to a reduction in the back emf, allowing more armature current to flow. The increase in armature current boosts the torque to meet the load demand effectively.

Therefore, the existence of back emf enables a dc motor to be 'self-regulating.'

Types of DC Motors

DC motors are usually classified on the basis of their excitation configuration, as follows –

- Separately excited (field winding is fed by external source)
- Self-excited –

- Series wound (field winding is connected in series with the armature)
- Shunt wound (field winding is connected in parallel with the armature)
- Compound wound – • Long shunt
- Short shunt

Applications of a DC Motor

It depends on the type of DC motor, which applications are ideal. Generally speaking, the following applications are common:

- Cranes
- Conveyors
- Pumps
- Fans
- Machine tools
- Air compressors
- Toys
- Motor starters in car

3.1.4.9V BATTERY:

This 9V General Purpose HIW Marked Non-Rechargeable Battery is designed to meet all your project and application requirements. With our extensive testing in the lab, we can guarantee the top quality, long lifespan, and authenticity of this battery compared to other options in the market at a similar price point. Its standardized 9V size and connection terminals make it versatile for various do-it-yourself projects and household uses, easily replaced and installed similar to AA or AAA batteries. If you require a new battery for various devices such as a flashlight, portable phone charger, wireless doorbell, wireless audio systems, or children's toys finding a reliable 9volt battery is essential. It is wise to have spare 9-volt batteries on hand for emergencies. Here, we have identified one of the best 9-volt batteries available.

Fig 3.9. 9V battery

3.2 SOFTWARE MODULE:

3.3.1 Arduino Software (IDE):

Fig 3.10 Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Writing Sketches:

Programs created with Arduino Software (IDE) are referred to as sketches. These sketches are written within the text editor and are saved with the .ino file extension. The editor includes tools for cutting, pasting, searching, and replacing text. Feedback during saving and exporting, as well as error messages, are shown in the message area. The console presents textual output from Arduino Software (IDE), such as error messages and other details. The bottom right corner of the window displays the selected board and serial port. Toolbar buttons enable users to verify and upload programs, manage sketches, and access the serial monitor.

NB: Prior to version 1.0 of the Arduino Software (IDE), sketches were saved with the .pde extension. If you attempt to open these files with version 1.0, you will receive a prompt to save the sketch with the .ino extension.

- * The five menus consist of File, Edit, Sketch, Tools, and Help, where additional commands can be found. These menus adapt to the context, ensuring that only relevant items for the current task are accessible.

File

- New

Creates a new instance of the editor, with the bare minimum structure of a sketch already in place.

- Open

Allows to load a sketch file browsing through the computer drives and folders.

- Open Recent

Provides a short list of the most recent sketches, ready to be opened.

- Sketchbook

Shows the current sketches within the sketchbook folder structure; clicking on any name opens the corresponding sketch in a new editor instance.

- Examples

Any example provided by the Arduino Software (IDE) or library shows up in this menu item. All the examples are structured in a tree that allows easy access by topic or library.

- Close

Closes the instance of the Arduino Software from which it is clicked.

- Save

Saves the sketch with the current name. If the file hasn't been named before, a name will be provided in a "Save as.." window.

- Save as...

Allows to save the current sketch with a different name.

- Page Setup

It shows the Page Setup window for printing.

- Print

Sends the current sketch to the printer according to the settings defined in Page Setup.

- Preferences

Opens the Preferences window where some settings of the IDE may be customized, as the language of the IDE interface.

- Quit

Closes all IDE windows. The same sketches open when Quit was chosen will be automatically reopened the next time you start the IDE.

Edit

- Undo/Redo

Goes back of one or more steps you did while editing; when you go back, you may go forward with Redo.

- Cut

Removes the selected text from the editor and places it into the clipboard.

- Copy

Duplicates the selected text in the editor and places it into the clipboard.

- Copy for Forum

Copies the code of your sketch to the clipboard in a form suitable for posting to the forum, complete with syntax colouring.

- Copy as HTML

Copies the code of your sketch to the clipboard as HTML, suitable for embedding in web pages.

- Paste

Puts the contents of the clipboard at the cursor position, in the editor.

- Select All

Selects and highlights the whole content of the editor.

- Comment/Uncomment

Puts or removes the // comment marker at the beginning of each selected line.

- Increase/Decrease Indent

Adds or subtracts a space at the beginning of each selected line, moving the text one space on the right or eliminating a space at the beginning.

- Find

Opens the Find and Replace window where you can specify text to search inside the current sketch according to several options.

- Find Next

Highlights the next occurrence - if any - of the string specified as the search item in the Find window, relative to the cursor position.

- Find Previous

Highlights the previous occurrence - if any - of the string specified as the search item in the Find window relative to the cursor position.

Sketch

- Verify/Compile

Checks your sketch for errors compiling it; it will report memory usage for code and variables in the console area.

- Upload

Compiles and loads the binary file onto the configured board through the configured Port.

- Upload Using Programmer
- To rewrite the bootloader on the board, utilize the Tools > Burn Bootloader option to restore it, enabling you to upload to the USB serial port again. This action enables you to utilize the complete Flash memory capacity for your sketch. It's important to note that this specific command doesn't alter the fuses. To do so, you must execute a Tools -> Burn Bootloader command.Export Compiled Binary

Saves a .hex file that may be kept as archive or sent to the board using other tools.

- Show Sketch Folder

Opens the current sketch folder.

- Include Library

Adds a library to your sketch by inserting #include statements at the start of your code. For more details, see libraries below. Additionally, from this menu item you can access the Library Manager and import new libraries from .zip files.

- Add File...

Adds a source file to the sketch (it will be copied from its current location). The new file appears in a new tab in the sketch window. Files can be removed from the sketch using the tab menu accessible clicking on the small triangle icon below the serial monitor one on the right side o the toolbar.

- Auto Format

This formats your code nicely: i.e. indents it so that opening and closing curly braces line up, and that the statements inside curly braces are indented more.

- Archive Sketch

Archives a copy of the current sketch in .zip format. The archive is placed in the same directory as the sketch.

- Fix Encoding & Reload

Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.

- Serial Monitor

Opens the serial monitor window and initiates the exchange of data with any connected board on the currently selected Port. This usually resets the board, if the board supports Reset over serial port opening.

- Board

Select the board that you're using. See below for descriptions of the various boards.

- Port

This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu.

- Programmer

For selecting a harware programmer when programming a board or chip and not using the onboard USB-serial connection. Normally you won't need this, but if you're burning a bootloader to a new microcontroller, you will use this.

- Burn Bootloader

The items in this menu allow you to burn a bootloader onto the microcontroller on an Arduino board. This is not required for normal use of an Arduino or Genuino board but is useful if you purchase a new ATmega microcontroller (which normally come without a bootloader). Ensure that you've selected the correct board from the Boards menu before burning the bootloader on the target board. This command also set the right fuses.

Help

Here you find easy access to a number of documents that come with the Arduino Software (IDE). You have access to Getting Started, Reference, this guide to the IDE and other documents locally, without an internet connection. The documents are a local copy of the online ones and may link back to our online website.

- Find in Reference

This is the only interactive function of the Help menu: it directly selects the relevant page in the local copy of the Reference for the function or command under the cursor.

Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog.

Beginning with version 1.0, files are saved with a .ino file extension. Previous versions use the .pde extension. You may still open .pde named files in version 1.0 and later, the software will automatically rename the extension to .ino.

Tabs, Multiple Files, and Compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

Uploading

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyACMx , /dev/ttyUSBx or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino bootloader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #includestatements from the top of your code.

There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these instructions for installing a third-party library.

To write your own library, see this tutorial.

Third-Party Hardware

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, bootloaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

For details on creating packages for third-party hardware, see the Arduino IDE 1.5 3rd party Hardware specification.

Serial Monitor

Displays serial data being sent from the Arduino or Genuino board (USB or serial board). To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down that matches the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux, the Arduino or Genuino board will reset (rerun your sketch execution to the beginning) when you connect with the serial monitor.

You can also talk to the board from Processing, Flash, MaxMSP, etc (see the interfacing page for details).

Preferences

Some preferences can be set in the preferences dialog (found under the Arduino menu on the Mac, or File on Windows and Linux). The rest can be found in the preferences file, whose location is shown in the preference dialog.

Language Support

Since version 1.0.1 , the Arduino Software (IDE) has been translated into 30+ different languages. By default, the IDE loads in the language selected by your operating system. (Note: on Windows and possibly Linux, this is determined by the locale setting which controls currency and date formats, not by the language the operating system is displayed in.)

If you would like to change the language manually, start the Arduino Software (IDE) and open the Preferences window. Next to the Editor Language there is a dropdown menu of currently supported languages. Select your preferred language from the menu, and restart the software to use the selected language. If your operating system language is not supported, the Arduino Software (IDE) will default to English.

You can return the software to its default setting of selecting its language based on your operating system by selecting System Default from the Editor Language drop-down. This setting will take effect when you restart the Arduino Software (IDE). Similarly, after changing your operating system's settings, you must restart the Arduino Software (IDE) to update it to the new default language.

Boards

The board selection has two effects: it sets the parameters (e.g. CPU speed and baud rate) used when compiling and uploading sketches; and sets and the file and fuse settings used by the burn bootloader command. Some of the board definitions differ only in the latter, so even if you've been uploading successfully with a particular selection you'll want to check it before burning the bootloader. You can find a comparison table between the various boards here.

Arduino Software (IDE) includes the built in support for the boards in the following list, all based on the AVR Core. The Boards Manager included in the standard installation allows to add support for the growing number of new boards based on different cores like Arduino Due, Arduino Zero, Edison, Galileo and so on.

- Arduino Yùn

An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.

- Arduino/Genuino Uno

An ATmega328 running at 16 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM.

- Arduino Diecimila or Duemilanove w/ ATmega168

An ATmega168 running at 16 MHz with auto-reset.

- Arduino Nano w/ ATmega328

An ATmega328 running at 16 MHz with auto-reset. Has eight analog inputs.

- Arduino/Genuino Mega 2560

An ATmega2560 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.

- Arduino Mega

An ATmega1280 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.

- Arduino Mega ADK

An ATmega2560 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.

- Arduino Leonardo

An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.

- Arduino/Genuino Micro

An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.

- Arduino Esplora

An ATmega32u4 running at 16 MHz with auto-reset.

- Arduino Mini w/ ATmega328

An ATmega328 running at 16 MHz with auto-reset, 8 Analog In, 14 Digital I/O and 6 PWM.

- Arduino Ethernet

Equivalent to Arduino UNO with an Ethernet shield: An ATmega328 running at 16 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM.

- Arduino Fio

An ATmega328 running at 8 MHz with auto-reset. Equivalent to Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328, 6 Analog In, 14 Digital I/O and 6 PWM.

- Arduino BT w/ ATmega328

ATmega328 running at 16 MHz. The bootloader burned (4 KB) includes codes to initialize the on-board bluetooth module, 6 Analog In, 14 Digital I/O and 6 PWM..

- LilyPad Arduino USB

An ATmega32u4 running at 8 MHz with auto-reset, 4 Analog In, 9 Digital I/O and 4 PWM.

- LilyPad Arduino

An ATmega168 or ATmega132 running at 8 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM.

- Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328

An ATmega328 running at 16 MHz with auto-reset. Equivalent to Arduino Duemilanove or Nano w/ ATmega328; 6 Analog In, 14 Digital I/O and 6 PWM.

- Arduino NG or older w/ ATmega168

An ATmega168 running at 16 MHz without auto-reset. Compilation and upload is equivalent to Arduino Diecimila or Duemilanove w/ ATmega168, but the bootloader burned has a slower timeout (and blinks the pin 13 LED three times on reset); 6 Analog In, 14 Digital I/O and 6 PWM.

- Arduino Robot Control

An ATmega328 running at 16 MHz with auto-reset.

- Arduino Robot Motor

An ATmega328 running at 16 MHz with auto-reset.

- Arduino Gemma

An ATtiny85 running at 8 MHz with auto-reset, 1 Analog In, 3 Digital I/O and 2 PWM.

CHAPTER 4

4.1 CONCLUSION:

In conclusion, the integration of RFID technology into automated path control for robots showcases a significant leap forward in precision navigation. The system's ability to interpret RFID tags allows for dynamic adjustments and enhanced adaptability in traversing predefined routes. This innovation holds promise across industries, offering reliable and efficient autonomous navigation in complex environments. The project demonstrates the potential for RFID-based systems to revolutionize robotics by providing real-time, granular control over path-following mechanisms. As a versatile and responsive solution, this technology promises increased efficiency, reduced maintenance, and improved adaptability, paving the way for future advancements in autonomous robotics and diverse applications. The exploration into RFID controlled automated path robots has culminated in a promising outlook for the field of robotics and automation. The conclusion drawn from various studies and experiments is that these robots are not only feasible but also highly efficient in navigating complex environments. The use of RFID technology for navigation and destination verification has proven to be a game-changer, ensuring high levels of accuracy and reliability. The discussion around these robots often centers on their potential applications, which range from industrial automation to service-oriented tasks like delivery and inventory management. The continuous improvements in RFID reading accuracy, obstacle detection, and path planning algorithms are pivotal in enhancing the robots' functionality. Moreover, the adaptability of these robots to different environments and tasks underscores their versatility and potential for widespread adoption. Overall, RFID controlled automated path robots stand at the forefront of innovation in autonomous systems, with their development marking a significant advancement in the automation sector. As the technology matures, it is anticipated that these robots will play an increasingly integral role in streamlining operations across various industries, thereby revolutionizing the way we approach logistics and navigation challenges

4.2 FUTURE WORK:

Integrations with Other Technologies*:*

The flexibility of RFID tags simplifies interaction with various technologies. The integration of intelligent RFID solutions will merge the key elements of contemporary warehouse procedures and the Internet of Things (IoT) in the times ahead.

Increased Sustainability:

Smart antennas, readers, and RFID tags are set to converge with powerful IoT edge computing. Users will utilize touch screens and various input devices to engage with these innovative solutions.

Adaptive Navigation:

These automated machines possess the capability to alter their paths based on real-time data. They can, for instance, adjust their routes dynamically to investigate further if they detect signs of illegal hunting, such as erratic movements.

Collaboration with Drones:

Drones and autonomous ground robots can collaborate to perform aerial surveillance together. While the ground robots are assigned to cover specific paths, drones equipped with RFID readers can efficiently scan expansive areas.

4.3 RESULT:

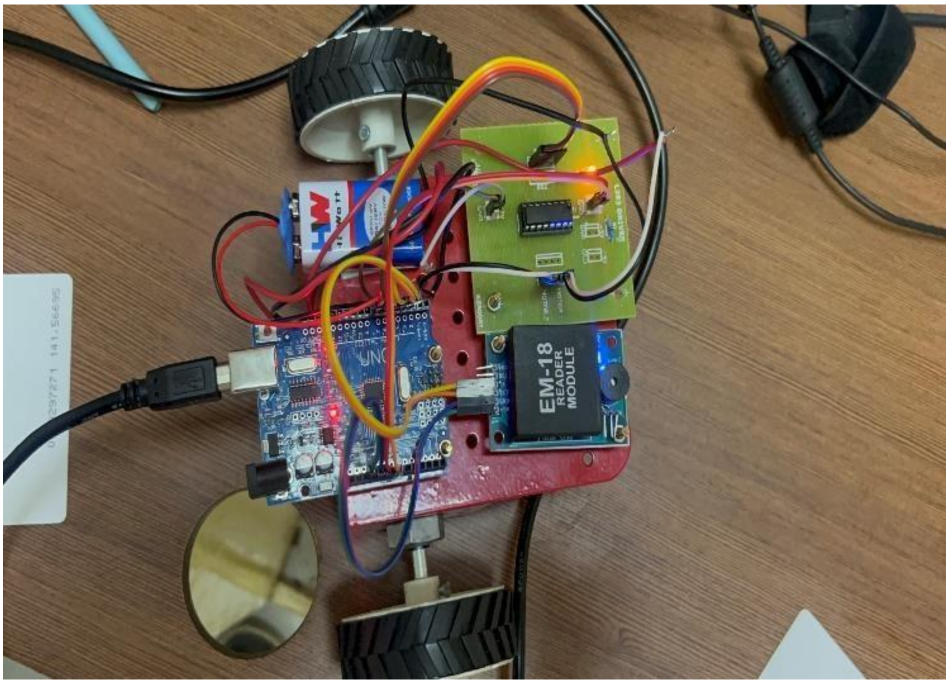

Fig 4.1 PROTOTYPE OF RFID CONTROLLED AUTOMATED PATH ROBOT

The outcomes of different research studies and the application of RFID-controlled automated path robots indicate that these systems are highly efficient for precise navigation and task completion in automated settings. By utilizing RFID technology, the robot can accurately determine its position along a predetermined route, a crucial aspect for tasks demanding accuracy. These findings suggest that RFID-controlled robots present a practical and effective solution for automation. An affordable option compared to more intricate navigation systems, RFID tags can be easily reconfigured to suit different layouts. Their versatility allows for use across various environments and tasks, ranging from basic material transportation to complex assembly processes. Despite the technology's potential, challenges arise in areas with high radio frequency interference or limited RFID reader range. However, ongoing advancements in RFID technology are expected to address these issues, enhancing system reliability and expanding its applications.

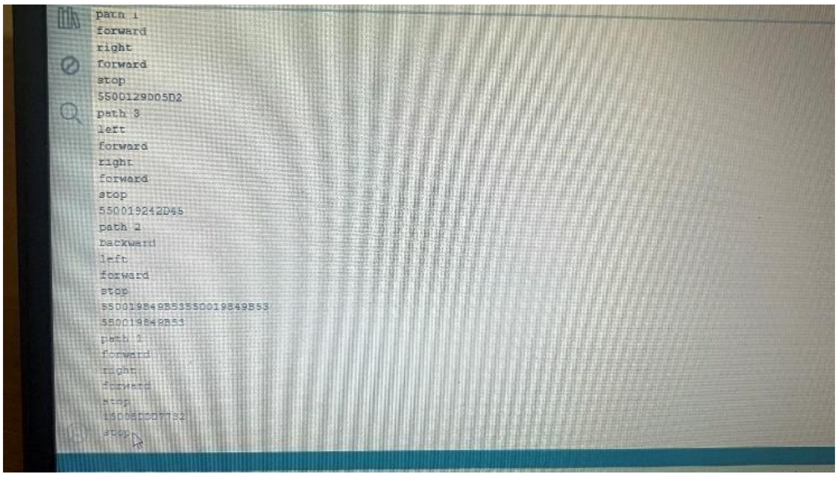

Fig 4.2 Software Result

The advancement of a robot guided by RFID technology for precise navigation highlights the significance of incorporating RFID technology into controlling automated paths in robots. By being able to interpret RFID tags, the system allows for on-the-fly adjustments and increased adaptability in following planned routes. This technological innovation provides reliable and efficient independent navigation in complex settings, showing potential for application across various industries. The study demonstrates the potential of RFID-based systems in enabling precise, real-time control of path-following mechanisms, offering a significant opportunity for revolutionizing the field of robotics. This adaptable and responsive technology paves the way for future advancements in autonomous robotics and a diverse array of applications. Additionally, it holds the promise of enhanced efficiency, reduced maintenance expenses, and increased flexibility. These studies highlight the potential of RFID controlled automated path robots in various applications, such as delivery systems in ride-sharing companies and other service sectors. The advancements in object detection and path planning algorithms have significantly improved the performance and usability of these robots.

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I)ANNEXURE :

```
#include<SoftwareSerial.h>
SoftwareSerial rfid(2,3);  //rx,tx
String rcv;
/*
  This sample sketch demonstrates the normal use of a TinyGPSPlus (TinyGPSPlus) object.
It requires the use of SoftwareSerial, and assumes that you have a    4800-baud serial GPS
device hooked up on pins 4(rx) and 3(tx).
*/

int motor1 =4; int
motor2 =5; int
motor3 =6; int
motor4 =7;
// The TinyGPSPlus object

void setup()
{
  pinMode(motor1,        OUTPUT);        pinMode(motor3,        OUTPUT);
pinMode(motor2, OUTPUT); pinMode(motor4, OUTPUT);

  Serial.begin(9600);

  rfid.begin(9600);
}
void loop()
{

  while (rfid.available())
```

```
  {
    rcv = rfid.readString();
    Serial.println(rcv);
//  }

  if(rcv=="550019849B53")
  {
    Serial.println("path 1");
    Serial.println("forward");
    analogWrite(motor1,150); analogWrite(motor2,0);
    analogWrite(motor3,150); analogWrite(motor4,0);
    delay(3000);
Serial.println("right");
    analogWrite(motor1,250);                    analogWrite(motor2,0);
analogWrite(motor3,0); analogWrite(motor4,0);
    delay(1000);
Serial.println("forward");
    analogWrite(motor1,150); analogWrite(motor2,0);



  analogWrite(motor3,150); analogWrite(motor4,0);
    delay(3000);
Serial.println("stop");
   analogWrite(motor1,0);                    analogWrite(motor2,0);
analogWrite(motor3,0); analogWrite(motor4,0);
  }
  if(rcv=="550019242D45")
  {
     Serial.println("path 2");
Serial.println("backward");    analogWrite(motor1,0);
analogWrite(motor2,150);    analogWrite(motor3,0);
analogWrite(motor4,150);
   delay(3000);
Serial.println("left");
    analogWrite(motor1,0);                    analogWrite(motor2,0);
analogWrite(motor3,250); analogWrite(motor4,0);
    Serial.println("forward");     delay(3000);
analogWrite(motor1,150); analogWrite(motor2,0);
analogWrite(motor3,150); analogWrite(motor4,0);
    delay(3000);
Serial.println("stop");
   analogWrite(motor1,0);                    analogWrite(motor2,0);
analogWrite(motor3,0); analogWrite(motor4,0);
  }
  if(rcv=="5500129005D2")
  {
```

```
Serial.println("path                    3");
Serial.println("left");
analogWrite(motor1,0);                  analogWrite(motor2,0);
analogWrite(motor3,250); analogWrite(motor4,0);
delay(2000);
Serial.println("forward");
//delay(4000);
analogWrite(motor1,150); analogWrite(motor2,0);
analogWrite(motor3,150); analogWrite(motor4,0);     delay(4000);
Serial.println("right");
analogWrite(motor1,250);                analogWrite(motor2,0);
analogWrite(motor3,0); analogWrite(motor4,0);
delay(3000);
Serial.println("forward");
```

```
analogWrite(motor1,150);                analogWrite(motor2,0);
analogWrite(motor3,150); analogWrite(motor4,0);
delay(4000);
Serial.println("stop");
analogWrite(motor1,0);                  analogWrite(motor2,0);
analogWrite(motor3,0); analogWrite(motor4,0);
}
if(rcv=="15008DDD7732")
{
Serial.println("stop");
analogWrite(motor1,0);                  analogWrite(motor2,0);
analogWrite(motor3,0); analogWrite(motor4,0);
}
}
}
```

International Conference on "Innovations and technological development in Electronics,Computers and Communication"

RFID CONTROLLED AUTOMATED PATH ROBOT

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***Abstract*— A system intended to navigate independently within a predetermined environment is summarized in the abstract of an RFID-controlled automated path robot. In order to obtain the robot's motion planning path more quickly, RFID technology allows for precise control over a robotic system's movements. This integration allows the robot to operate autonomously through pre-planned routes or challenging terrain without requiring human assistance. By placing RFID tags strategically along a predetermined path, this system uses Radio Frequency Identification (RFID) technology to direct the robot. As waypoints, these tags give the robot directions and position information. Microcontrollers, usually small, powerful units like the NODEMCU ESP8266, are at the core of the robot's control system. They interpret the signals that come in from the RFID reader A variety of industries looking to boost productivity and cut expenses can find the system to be a compelling option due to its scalability and flexibility.**

In summary, The RFID-controlled automated path robot, which combines advanced control systems and RFID technology to create a dependable and adaptable automated assistant that can navigate challenging environments, is a major advancement in robotics.

Keywords— *Radio frequency identification(RFID), pre-planned routed , RFID reader.*

Introduction:

In today's technological landscape, autonomous navigation is crucial for many industries, including manufacturing, logistics, and smart infrastructure. The use of RFID technology in robotics provides a workable solution for precise and efficient path control. The purpose of this project is to use tags and RFID readers to build a robotic system that can precisely follow predefined routes. By integrating RFID technology, the system gains the capability to identify and interpret RFID tags that are placed strategically along the intended route. Thanks to this communication, the robot is able to follow predefined paths, adjust its movements, and potentially even make decisions based on the information it receives from the RFID tags. In order to provide precise path control in sectors such as manufacturing, logistics, and smart infrastructure, this project intends to create a robotic system that makes use of RFID technology. By identifying and interpreting RFID tags, the system enables the robot to follow preset routes, adjust its motions, and make choices. The integration of RFID-controlled navigation holds great potential benefits for applications such as transportation, warehouse management, and surveillance, which all require automated and controlled movement. This project's goal is to find out if RFID technology can increase robotic navigation systems' accuracy and independence. We aim to showcase the robotics capabilities of RFID-based control systems through this project, as they offer an innovative and practical approach to autonomous path navigation for various practical applications. By incorporating RFID technology into robotic navigation systems, we hope to demonstrate improved efficiency and precision in navigating complex environments. Ultimately, this research aims to contribute to the advancement of autonomous robotics technology and its integration into various industries.

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