JOYSTICK CONTROLLED INDUSTRIAL AUTOMATION SYSTEM

A MINI PROJECT REPORT

Submitted by

AARTHI E	**(8115U21EE002)**
PARVATHI A	**(8115U21EE037)**
SARIGA U	**(8115U21EE042)**
TAMIMA TACITA T	**(8115U21EE047)**

in partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

K. RAMAKRISHNAN COLLEGE OF ENGINEERING
(AUTONOMOUS)
SAMAYAPURAM, TRICHY

ANNA UNIVERSITY

CHENNAI 600 025

MAY 2024

JOYSTICK CONTROLLED INDUSTRIAL AUTOMATION SYSTEM

UEE1612 UG MINI PROJECT

Submitted by

AARTHI E	**(8115U21EE002)**
PARVATHI A	**(8115U21EE037)**
SARIGA U	**(8115U21EE042)**
TAMIMA TACITA T	**(8115U21EE047)**

in partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

Under the Guidance of

Mr. G.GABRIEL SANTHOSH KUMAR

Department of Electrical and Electronics Engineering

K. RAMAKRISHNAN COLLEGE OF ENGINEERING

ELECTRICAL AND ELECTRONICS ENGINEERING

K. RAMAKRISHNAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Under

ANNA UNIVERSITY, CHENNAI

K. RAMAKRISHNAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Under

ANNA UNIVERSITY, CHENNAI

BONAFIDE CERTIFICATE

Certified that this project report titled "**JOYSTICK CONTROLLED INDUSTRIAL AUTOMATION SYSTEM"** is the bonafide work of **AARTHI E (8115U21EE002), PARVATHI A (8115U21EE037), SARIGA U (8115U21EE042),** and **TAMIMA TACITA T (8115U21EE047)** who carried out the work under my supervision.

Mr.G.GABRIEL SANTHOSH KUMAR
HEAD OF THE DEPARTMENT
ASSISTANT PROFESSOR,
Department of Electrical and Electronics Engineering,
K. Ramakrishnan College of Engineering, (Autonomous)
Samayapuram, Trichy.

Mr.G.GABRIEL SANTHOSH KUMAR
SUPERVISOR
ASSISTANT PROFESSOR,
Department of Electrical and Electronics Engineering,
K. Ramakrishnan College of Engineering, (Autonomous)
Samayapuram, Trichy.

SIGNATURE OF INTERNAL EXAMINER

NAME:

DATE:

SIGNATURE OF EXTERNAL EXAMINER

NAME:

DATE:

K. RAMAKRISHNAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Under

ANNA UNIVERSITY, CHENNAI

DECLARATION BY THE CANDIDATE

I declare that to the best of my knowledge the work reported here in has been composed solely by myself and that it has not been in whole or in part in any previous application for a degree.

Submitted for the Mini Project Viva Voce held at K. Ramakrishnan College of Engineering on _________

SIGNATURE OF THE CANDIDATE

K. RAMAKRISHNAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Under

ANNA UNIVERSITY, CHENNAI

DECLARATION BY THE CANDIDATE

I declare that to the best of my knowledge the work reported here in has been composed solely by myself and that it has not been in whole or in part in any previous application for a degree.

Submitted for the Mini Project Viva Voce held at K. Ramakrishnan College of Engineering on _________

SIGNATURE OF THE CANDIDATE

K. RAMAKRISHNAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Under

ANNA UNIVERSITY, CHENNAI

DECLARATION BY THE CANDIDATE

I declare that to the best of my knowledge the work reported here in has been composed solely by myself and that it has not been in whole or in part in any previous application for a degree.

Submitted for the Mini Project Viva Voce held at K. Ramakrishnan College of Engineering on _________

SIGNATURE OF THE CANDIDATE

K. RAMAKRISHNAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Under

ANNA UNIVERSITY, CHENNAI

DECLARATION BY THE CANDIDATE

I declare that to the best of my knowledge the work reported here in has been composed solely by myself and that it has not been in whole or in part in any previous application for a degree.

Submitted for the Mini Project Viva Voce held at K. Ramakrishnan College of Engineering on _________

SIGNATURE OF THE CANDIDATE

INSTITUTE VISION AND MISSION

VISION

To achieve a prominent position among the top technical institutions

MISSION

- To bestow standard technical education par excellence through state of the artinfrastructure, competent faculty and high ethical standards.
- To nurture research and entrepreneurial skills among students in cutting edgetechnologies.
- To provide education for developing high-quality professionals to transform thesociety.

DEPARTMENT VISION AND MISSION

VISION

To emerge as a renowned department for high quality teaching, learning and research in the domain of Electrical and Electronics Engineering, producing professional engineers, to meet the challenges of society

MISSION

M1. To establish the infrastructure resources for imparting quality technical education inElectrical and Electronics Engineering.

M2. To achieve excellence in teaching, learning, research and development.

M3. To impart the latest skills and developments through practical approach along withmoral and ethical values.

PROGRAM SPECIFIC OUTCOME (PSO)

PSO1: Use logical and technical skills to model, simulate and analyze electrical components and systems

PSO2: Integrate the knowledge of fundamental electrical and electronics, power electronics and control systems for the reliability, sustainability and controllability of the electrical systems.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Have strong foundation in Electrical and Electronics Engineering to excel inprofessional career, in higher studies or research.

PEO2: Analyze, design and develop various interdisciplinary projects and products, tosolve social issues.

PEO3: Have professional ethics and effective communication skills with life-long learning attitudes.

PROGRAM OUTCOME (PO)

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team work: Function effectively as an individual, and as a memberor leader in diverse teams, and in multidisciplinary settings

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Demonstrate knowledge and understanding ofthe engineering and management principles and apply these to one’s own work, as amember and leader in a team, to manage projects and in multidisciplinary environments. **PO12 Life-long learning:** Recognize the need for, and have the preparation and abilityto engage in independent and life-long learning in the broadest context of technologicalchange

COURSE OUTCOMES:

SNO	BLOOMS LEVEL	DESCRIPTION	PO(1..12) & PSO(1..2) MAPPING
C318.1	K3	To expose the students to apply knowledge to solve problems.	PO1, PSO1, PSO2
C318.2	K3	To expose the students to find solutions to complex problems, issues for public and environmental concerns.	PO3, PO7, PSO1, PSO2
C318.3	K3	To expose the students to give conclusions, analyze methods for various scenarios.	PO4, PSO1, PSO2
C318.4	K2	To expose the students to communicate efficiently their technical knowledge and concepts.	PO9, PO10, PSO2
C318.5	K2	To expose the students to self learning and long term learning processes.	PO12, PSO1

COURSE OUTCOMES VS POS MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

SNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C318.1	3	-	-		-	-	-	-	-	-	-	-	2	3
C318.2	-	-	3	-	-	-	3	-	-	-	-	-	2	3
C318.3	-	-		3	-	-	-	-	-	-	-	-	2	3
C318.4	-	-	-	-	-	-	-	-	3	3	-	-	-	2
C318.5	-	-	-	-	-	-	-	-	-	-	-	3	2	-

* For Entire Course, PO /PSO Mapping; 1 (Low); 2(Medium); 3(High) Contribution to PO/PSO

ABSTRACT

In modern industrial settings, automation plays a pivotal role in enhancing efficiency and productivity. Traditional methods often involve complex interfaces or limited mobility. To address this challenge, this project proposes a joystick-controlled industrial automation system utilizing Arduino Nano microcontroller technology. A joystick, serving as the primary input device, allows for intuitive and precise control over the industrial machinery. By translating the joystick's analog signals into digital commands, the Arduino Nano facilitates real-time communication with the automation components. Firstly, the joystick module captures the operator's input, detecting movements along both the X and Y axes. These analog signals are then processed by the Arduino Nano.Through the integration of suitable drivers and relays, the Arduino Nano communicates with actuators such as motors, valves, or solenoids, enabling dynamic control over industrial processes.

ACKNOWLEDGEMENT

We thank the Almighty God, for showing abundance of grace, without his blessings it would not have been possible for us to complete our project.

At this pleasing moment of having successfully completed our project, we wish to convey our sincere thanks and gratitude to our beloved kind Chairman, **Dr.K.Ramakrishnan,** who provided all the facilities to us.

Our sincere gratitude to **Dr.S.Kuppusamy,** Executive Director for his constant encouragement. We are also grateful to our Principal **Dr. D.Srinivasan** for constructive suggestions and encouragement during our project.

We wish to express the profound thanks to **Mr. G. Gabriel Santhosh Kumar,** Assistant Professor and Head, Department of Electrical & Electronics Engineering, for providing all necessary facilities for doing this project.

We whole heartedly acknowledge our deep sense of gratitude and indebtedness to beloved guide **Mr. G. Gabriel Santhosh Kumar**, Assistant Professor and Head, Department of Electrical & Electronics Engineering, for his expert guidance and encouragement throughout the project.

We extend our gratitude to all the teaching & non-teaching staff members of Electrical & Electronics Engineering Department, **K.Ramakrishnan College of Engineering**, for their kind help and valuable support to complete the project successfully. We would like to thank our parents and friends for their constant support and encouragement throughout this project.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVATION

JM	JOYSTICK MODULE
RL	RELAY
ADC	ANALOG TO DIGITAL CONVERTER
DC	DIRECT CURRENT
AC	ALTERNATIVE CURRENT
IC	INTEGRATED CIRCUIT
LED	LIGHT EMITTING DIODE
IDE	INTEGRATED DEVELOPMENT ENVIRONMENT

CHAPTER 1

INTRODUCTION

In today's rapidly evolving industrial landscape, the quest for efficiency, precision, and safety in automation processes has become paramount. The integration of innovative control mechanisms has emerged as a cornerstone in addressing these imperatives. Among the plethora of technologies facilitating industrial automation, joystick-controlled systems represent a compelling paradigm, offering intuitive and versatile control interfaces. This introduction sets the stage for exploring the fusion of joystick control with industrial automation, specifically focusing on its implementation using the Arduino Nano microcontroller platform.

The advent of Arduino Nano has revolutionized the landscape of DIY electronics and prototyping, offering a compact yet powerful solution for developing a wide array of embedded systems. Its affordability, ease of use, and extensive community support have made it a preferred choice for hobbyists, educators, and professionals alike. Leveraging the capabilities of Arduino Nano for industrial automation underscores the democratization of technology, enabling small to medium-scale enterprises to harness sophisticated control solutions without exorbitant investments.Joystick control serves as a natural interface for human-machine interaction, mimicking the manual dexterity of human operators while affording precise control over complex machinery. In industrial settings, where operators oversee intricate processes ranging from robotic arms to conveyor belts, the adoption of joystick-based control systems introduces a seamless means of orchestrating these operations.

The intuitive nature of joystick manipulation reduces the learning curve for operators, empowering them to execute tasks with agility and finesse.The incorporation of joystick control with industrial automation using Arduino Nano heralds a new era of flexibility and adaptability in manufacturing and production environments. By interfacing joystick modules with Arduino Nano, operators can commandeer a diverse array of actuators, sensors, and feedback mechanisms, orchestrating intricate sequences of operations with ease. Whether it's maneuvering a robotic arm along predefined trajectories or regulating the flow of materials through intricate pipelines, the amalgamation of joystick control and Arduino-powered automation imbues industrial processes with newfound efficiency and precision.

Moreover, the modular architecture of Arduino Nano-based systems lends itself to scalability and customization, allowing businesses to tailor automation solutions to their specific needs. Whether deployed in automotive assembly lines, pharmaceutical manufacturing facilities, or warehouse logistics systems, joystick-controlled industrial automation systems offer a versatile toolkit for streamlining operations and enhancing productivity. Furthermore, the open-source ethos underpinning Arduino Nano fosters a collaborative ecosystem of innovation, where developers can leverage and build upon existing libraries and frameworks to continually enhance the capabilities of their automation systems.

In summary, the convergence of joystick control with industrial automation using Arduino Nano encapsulates the ethos of innovation and accessibility driving modern manufacturing paradigms. By democratizing sophisticated control solutions and empowering operators with intuitive interfaces, this fusion promises to redefine the contours of industrial automation, ushering in an era of unparalleled efficiency, precision, and safety.

CHAPTER 2

LITERATURE SURVEY

S.NO	AUTHOR	TITLE	YEAR OF PUBLISHING	DESCRIPTION
1	**Gaikwad Ankita,** **Madke Devendra,** **Gavhane Aarti B,** **Vidhate Kalpana**	Arduino	2023	The mentioned project consumes more power whereas this project consumes **less power**. Additionally we make **use of joystick**.
2	**Kumar**	Design and Implementation of Robotic Arm Control Using Arduino	2020	The proposed model gives the viewer a wider and more precise outlook on the **wide applications this project can attain**.

3	**Islam**	Development of an Arduino-based Automation System for Industrial Environment	2019	The proposed model enables the user to form a chain of water supply for a single purpose, whereas this project is **multipurpose using joystick**.
4	**Li**	Design of Industrial Remote Control System Based on Arduino	2018	**Harmless and efficient** model of joystick can be used in this model in **rural areas**

Despite the limited literature specifically addressing joystick-controlled industrial automation using Arduino Nano, there is ample research on related topics such as Arduino-based control systems, remote control interfaces, and industrial automation. As interest in this area continues to grow, it is likely that more studies will emerge, providing further insights and advancements in the field.

MERITS AND DEMERITS OF JOYSTICK CONTROLLED INDUSTRIAL AUTOMATION SYSTEM

2.1 MERITS

Joystick-controlled industrial automation offers several merits, especially in scenarios where precise control and maneuverability are crucial:

1. **Precision Control**: Joysticks provide fine-tuned control over machinery movements, allowing operators to make precise adjustments in real-time. This level of control is particularly useful in tasks where accuracy is paramount, such as assembly line operations or robotic manipulation.
2. **Intuitive Interface**: Joysticks are intuitive to use, requiring minimal training for operators to become proficient. Their ergonomic design allows for natural hand movements, reducing the risk of operator fatigue and improving productivity.
3. **Flexibility**: Joystick-controlled systems are highly adaptable and can be easily customized to suit various applications. Operators can quickly switch between different modes or configurations to accommodate changing tasks or environments.
4. **Remote Operation**: With advancements in technology, joystick controls can be integrated with remote operation systems, allowing operators to control machinery from a distance. This capability enhances safety in hazardous environments and enables operators to access hard-to-reach areas more easily.
5. **Reduced Downtime**: By providing operators with greater control and responsiveness, joystick-controlled systems can help minimize downtime due to errors or inefficiencies. Operators can quickly identify and address issues as they arise, optimizing overall equipment effectiveness (OEE).

2.2 DEMERITS

While joystick-controlled industrial automation offers several advantages, it also has some limitations and potential drawbacks:

1. **Limited Precision**: While joysticks offer intuitive control, they may not provide the same level of precision as other control methods, such as programmable logic controllers (PLCs) or computer numerical control (CNC) systems. This limitation can impact the accuracy of movements, especially in highly precise manufacturing processes.
2. **Operator Fatigue**: Continuous operation of joysticks can lead to operator fatigue over time, particularly in applications that require prolonged periods of manual control. Fatigue can affect operator performance and increase the risk of errors or accidents.
3. **Training Requirements**: While joysticks are generally intuitive to use, operators still require training to effectively control machinery using this interface. Inexperienced operators may struggle to achieve optimal performance or may inadvertently cause damage to equipment.
4. **Limited Feedback**: Joysticks typically provide limited feedback to operators regarding the status of the machinery or the environment. This lack of feedback can make it challenging for operators to assess the effectiveness of their actions or identify potential issues.
5. **Risk of Accidental Operation**: In environments with multiple operators or complex machinery, there is a risk of accidental joystick operation, leading to unintended movements or collisions. Proper safety protocols and controls must be in place to mitigate this risks.

CHAPTER 3

CONCEPTUAL OF JOYSTICK CONTROLLED INDUSTRIAL AUTOMATION

3.1 BLOCK DIAGRAM

Joystick controlled industrial automation can be used to control up to four industrial electrical appliances with the help of a joystick and an Arduino Nano board. The block diagram of the joystick-controlled industrial automation system is shown in Fig.3.1.

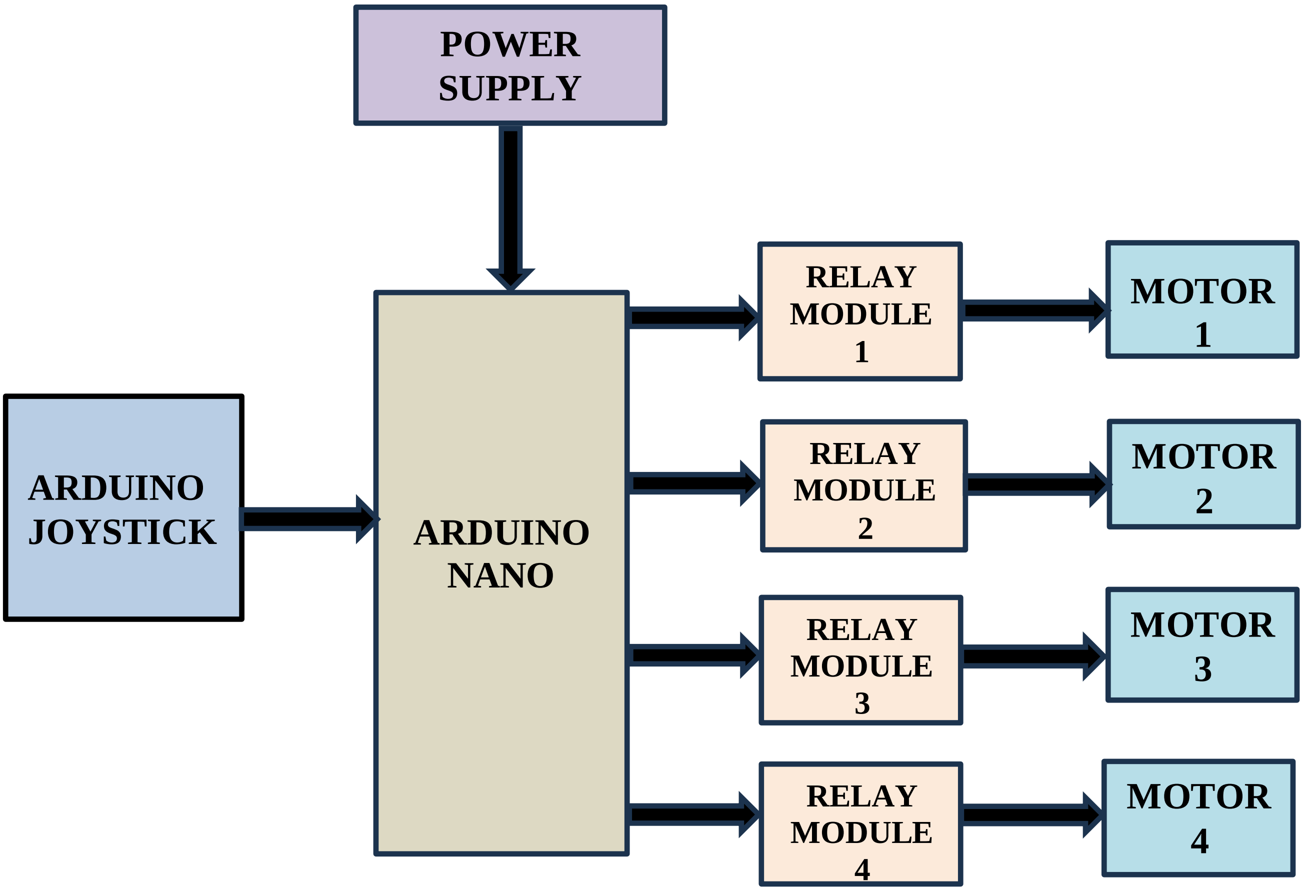


Fig.no.3.1 block diagram

ARDUINO JOYSTICK:

Joystick function in Arduino is a way to read analog inputs from a joystick module connected to the Arduino board. It typically involves using two analog pins to read the X and Y positions of the joystick.

POWER SUPPLY:

The power supply function in Arduino refers to how the Arduino board is powered. It can be powered via USB, a DC power jack, or VIN pin. The recommended voltage for most Arduino boards is 5V, but some can handle a range of voltages.

ARDUINO NANO:

The Arduino Nano is a compact microcontroller board based on the ATmega328P chip, similar to the Uno but smaller in size. It's great for projects where space is limited. The Nano has digital and analog pins for interfacing with sensors, actuators, and other electronic components. It can be programmed using the Arduino IDE via USB. It's widely used in robotics, IoT, and various electronic projects due to its small form factor and versatility.

RELAY MODULE:

A relay module is an electromechanical device that allows you to control high-power electrical devices with low-power signals, such as those from a microcontroller like Arduino. It consists of a relay (which is essentially a switch) and a control circuit. When the control circuit receives a signal, typically from a microcontroller, it energizes the relay, allowing it to switch a higher voltage or current circuit on or off.

MOTOR:

The motor function in Arduino allows you to control various types of motors, such as DC motors, stepper motors, and servo motors. With the motor function, you can control the speed, direction, and position of motors to drive mechanical systems in your projects, such as robots, CNC machines, or automated devices.

3.2 EXPLANATION OF JOYSTICK CONTROLLED INDUSTRIAL AUTOMATION

Joystick-controlled industrial automation refers to the use of a joystick interface to maneuver and control various automated processes within industrial settings. This method allows operators to manipulate machinery, such as robotic arms or conveyor systems, with precision and ease by simply moving the joystick in desired directions.

It enables real-time adjustments and facilitates intuitive control over complex machinery, enhancing efficiency and safety in manufacturing and production environments. Joystick-controlled automation streamlines operations, minimizes human error, and offers flexibility in adapting to diverse tasks, making it a valuable tool in modern industrial automation systems.

The above block diagram of the joystick controlled industrial automation consists of Power Supply,Arduino Joystick,Arduino Nano,Relay Driver,Relays and Motors.

Joystick-controlled industrial automation systems find applications in various industries such as manufacturing, logistics, agriculture, and construction. They are particularly useful in situations that require precise and intuitive control of machinery or robotic systems. Overall it offers a flexible and user-friendly interface for controlling complex industrial processes, enhancing productivity, efficiency and safety.

CHAPTER 4

IMPLEMENTATION OF JOYSTICK CONTROLLED INDUSTRIAL AUTOMATION USING ARDUINO NANO

4.1 HARDWARE REQUIREMENTS

4.1.1 POWER SUPPLY

Regulated power supply is designed with a full-wave rectifier circuit. It consists of D1 and D2 (1N4007) rectifier diodes, capacitors C1 and C2, IC1 7805 and 230V AC primary to 12V-0-12V, 750mA stepdown transformer (X1). In this project, mainly two voltages are required: 12V and 5V. 12V DC is used for relays, and 5V for Arduino Nano MCU.

4.1.2 JOYSTICK

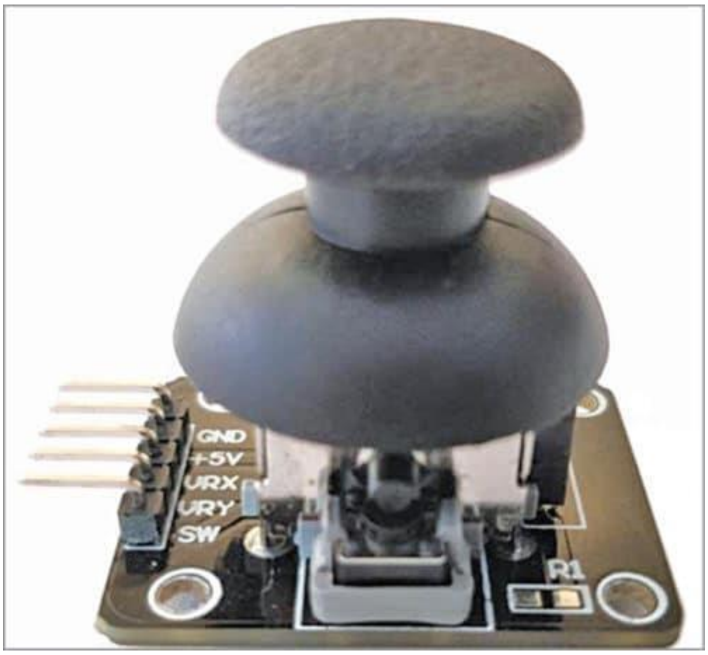


Fig no. 4.1 Joystick Module

Joysticks are available in different shapes and sizes.This joystick module provides analogue voltage outputs. Output voltage changes according to direction of the shaft. You can get direction of shaft movement by interpreting voltage changes using a microcontroller (MCU).

This joystick module has two axes: x and y. Each axis is controlled by shaft of the potentiometer mounted on of the joystick module. Potentiometer outputs VRx and VRy at connector CON1 are variable points. VRx and VRy act as the voltage divider.

When joystick shaft is in normal position, it is in standby mode. When it is moved along horizontal axis (right and left), voltage at VRx pin changes. Similarly, when it is moved along vertical axis (up and down), voltage at VRy pin changes. So, we have four different output signals for four directions of the joystick, which are connected to two analogue-to-digital converter (ADC) input pins A0 and A1 of Arduino Nano.

When the shaft is moved, voltage on each pin goes high or low depending on direction. The joystick module also comes with one push-button switch for interruption purpose (this function is not used here). The joystick module is interfaced with Arduino Nano, which comes with an inbuilt ADC, as shown in Fig. 4.1.

Arduino Nano drives four relays (RL1 through RL4) through its pins D2, D3, D4 and D5.

4.1.3 ARDUINO NANO

Fig.no.4.2 Arduino Nano

It is a small board compatible with ATMega 328 MCU. It has the following features:

- Operating voltage (logic level): 5V
- Input voltage (recommended): 7V-12V
- Input voltage (limits): 6V-20V
- Fourteen digital I/O pins (of which six provide PWM output)
- Eight analogue input pins
- DC current per I/O pin: 40mA
- Flash memory: 32kB (ATmega 328), of which 2kB is used by bootloader
- SRAM: 2kB (ATmega328)
- EERROM: 1kB
- Clock speed: 16MHz

4.1.4 MOTORS

Fig no. 4.3 Motor

Four motors with the specification of 30 rpm are used and they based on the movement of joystick the corresponding motor will operate.

4.1.5 BATTERY

- Powering the Arduino Nano: The Arduino Nano needs a power source to operate. While it can be powered through its USB port or VIN pin using an external power supply (such as a USB cable connected to a computer or a wall adapter), a 9V battery can provide a portable power solution, allowing the system to operate without being tethered to a fixed power outlet.

- Powering the Joystick Module: The joystick module also requires power to operate. Most joystick modules operate at 5V, so the Arduino Nano can provide the necessary power to the joystick module through its 5V pin. However, if the joystick module draws a significant amount of current or if a separate power source is preferred for isolation, the 9V battery can power the joystick module independently.

- Driving the Motors: While the Arduino Nano can be powered through the USB port or VIN pin, these power sources may not provide sufficient current to drive the motors directly. Therefore, a separate power source, such as the 9V battery, can be used to power the motor drivers and the motors themselves. This ensures that the motors receive an adequate power supply to operate effectively

Fig.no. 4.4 Battery

4.1.6 RELAY

- Relays: Relays are used to control the operation of high-power devices or equipment based on inputs from the joystick. For example, they can be used to start/stop motors, switch on/off lights, or activate/deactivate other industrial machinery.

- Relay Drivers: Relay drivers amplify the current or voltage signals from the Arduino Nano to control the relay coils effectively. They ensure that the relay coils receive sufficient power to change the switch state reliably.

- LEDs: LEDs are used to provide visual feedback to the operator about the system's status or the activation of specific functions. For example, an LED may illuminate when a motor is activated, when a particular operation is in progress, or when specific conditions are met.

Fig no. 4.5 12V,Single changeover relay

4.1.7 WIRING AND CONNECTIONS

In a joystick-controlled industrial automation system using Arduino Nano, wiring and connections play a crucial role in ensuring proper communication between components and reliable operation of the system. Here's how wiring and connections are typically used in such a setup:

- **Joystick Wiring**: The joystick module typically consists of multiple pins for power supply (VCC), ground (GND), and analog or digital output signals (X-axis and Y-axis).Connect the VCC pin of the joystick module to the 5V output pin of the Arduino Nano and the GND pin to the ground (GND) pin of the Arduino Nano.

  The X-axis and Y-axis output pins of the joystick module are connected to analog input pins (e.g., A0 and A1) of the Arduino Nano to read the position values corresponding to joystick movements.

- **Motor Driver Wiring:** Depending on the type of motors used (e.g., DC motors, stepper motors), motor driver modules are employed to interface between the Arduino Nano and the motors.

  Connect the control pins of the motor driver module (e.g., IN1, IN2, IN3, IN4 for an L298N motor driver) to digital output pins of the Arduino Nano to control the direction and speed of the motors.Connect the motor power supply terminals of the motor driver module to an external power supply suitable for the motors being used.

- **Relay Wiring:** If relays are used to control high-power devices or equipment, wire the relay coils to digital output pins of the Arduino Nano.Ensure proper connection of the relay contacts to the controlled devices or equipment, such as motors, lights, or other industrial machinery.
- **LED Wiring:** Connect the LEDs to digital output pins of the Arduino Nano via appropriate current-limiting resistors to prevent excessive current flow.

  LEDs can be used as visual indicators to provide feedback to the operator about the system's status or the activation of specific functions.

- **Power Supply Wiring:** Provide a stable power supply to the Arduino Nano, joystick module, motor drivers, relays, LEDs, and other components.

  Use appropriate power sources (e.g., USB power supply, batteries, external power adapters) to meet the voltage and current requirements of the components.

4.2 SOFTWARE REQUIREMENTS

4.2.1 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

Fig no. 4.6 Ardunio IDE

Main operation is done by the software program loaded into the internal memory of Arduino Nano. The program is written in Arduino programming language or sketch. Arduino IDE 1.6.8 is used to compile and upload the program.

ATmega328P on Arduino Nano board comes with a pre-programmed bootloader that allows you to upload a new code to it without using an external hardware programmer.

Connect Arduino Nano board to the PC and select the correct COM port in Arduino IDE. Compile the program/sketch (joystick_control.ino) and select the correct board from Tools->Board menu in Arduino IDE. Upload the sketch to load the program to the internal memory of the MCU. The sketch is at the heart of the system and carries out all major functions. In this project, external header files are not required for programming. It is a simple way to detect joystick values, and compare VRx and VRy values using if-else ladder functions to control four appliances.

The Arduino IDE is a user-friendly, open-source platform for programming Arduino boards. It offers cross-platform compatibility, integrated development features, and extensive community support, making it ideal for rapid prototyping and learning.

Semiconductors:	
❖ T1-T4	• 7805, 5V regulator
❖ D1-D6	• Arduino Nano board
❖ LED1- IC1	• BC547 npn transistor
❖ Board1	• 1N4007 rectifier diode
❖ LED4	• 5mm LED
Resistors (all 1/4-watt, ±5 carbon):	
❖ R1-R8	• 1-kilo-ohm
Capacitors:	
❖ C1	• 1000µF, 35V electrolytic
❖ C2	• 0.1µF ceramic
Miscellaneous:	
❖ JM1	• 5-pin joystick module
❖ RL-RL4	• 12V, single-changeover relay
❖ X1	• 230V AC primary to 12V-0-12V, 750mA secondary transformer

Fig.no.4.7 Parts list

CHAPTER 5

OVERALL CIRCUIT DIAGRAM DESCRIPTION

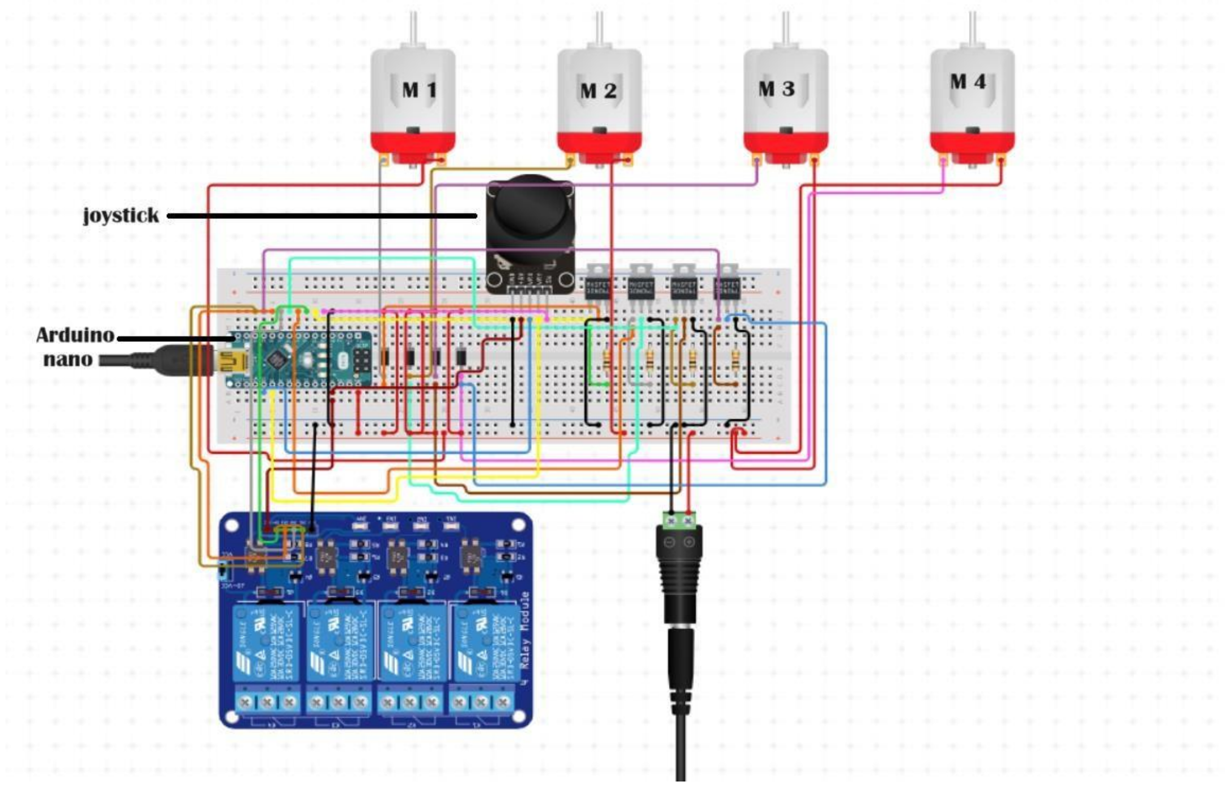


Fig.5.1 Circuit diagram

5.1 OPERATION

When the joystick module is in ideal state, digital value for both VRx and VRy is 512. ADC of Arduino is ten-bit, and digital value varies from 0 to 1023 levels according to analogue voltage received from the joystick. Ideally, the joystick is in midpoint or standby mode, so value shows is 5.1.

- **Case 1**

  When you move the shaft in x-left direction, digital value is less than 50. In this condition, pin D2 of Board1 is made high from the program, BC547 transistor T1 conducts, relay RL1 is energised and load connected across RL1 turns on. Diode D3 is used as freewheeling diode to eliminate back EMF.

- **Case 2**

  When you move the shaft in x-right direction, digital value is greater than 900. In this condition, pin D3 of Board1 is made high, BC547 transistor T2 conducts, relay RL2 is energised and electrical load/device connected across RL2 turns on.

- **Case 3**

  When you move the shaft in y-down direction, digital value is less than 50. Here, pin D4 is made high, BC547 transistor T3 conducts, relay RL3 is energised and load connected across RL3 turns on.

- **Case 4**

  When you move the shaft in y-up direction, digital value is greater than 900. Here, pin D5 of Board1 is made high, BC547 transistor T4 conducts, relay RL4 is energised and load connected across RL4 turns on.

5.2 CONNECTIONS

Connect the power supply from the transformer to the PCB at X1. Connect joystick output wires to the PCB at JM1. After loading the program into Arduino Nano, as described earlier, mount it on the PCB on the space provided for it. Switch on the power supply. Now you can move the shaft left, right, up and down to control the respectively.

CONCLUSION

Joystick-controlled industrial automation, facilitated by Arduino Nano, offers a compelling blend of intuitive control, adaptability, and affordability. Its simplicity enables operators to interact with machinery effortlessly, enhancing productivity and reducing errors. The Arduino Nano's versatility allows for seamless integration with various sensors and actuators, empowering customization to suit diverse industrial applications.

Despite its promise, challenges persist. Reliability and robustness are paramount in harsh industrial environments, demanding careful attention to enclosure design and component selection. Integration with existing machinery requires thorough planning and compatibility testing, while addressing programming complexities may necessitate specialized expertise.

Nevertheless, joystick-controlled automation democratizes industrial automation, making it accessible to small and medium-sized enterprises (SMEs). Its affordability and adaptability level the playing field, fostering innovation and competitiveness within the industrial landscape. By embracing joystick-controlled automation, businesses can streamline workflows, enhance efficiency, and drive growth.

In conclusion, joystick-controlled industrial automation represents a transformative approach to machinery operation. Its simplicity, adaptability, and affordability empower businesses to embrace automation, driving productivity gains and competitiveness. While challenges exist, addressing them adeptly can unlock the full potential of joystick-controlled automation, ushering in a new era of agility and efficiency in industrial settings

FUTURE ASPECTS

The future of joystick-controlled industrial automation utilizing Arduino Nano holds several exciting possibilities, driven by advancements in technology and the evolving landscape of industrial automation:

1) **Miniaturization and Integration**: As technology continues to shrink in size and improve in performance, Arduino Nano boards may become even smaller and more power-efficient. This could lead to the integration of joystick control directly into machinery or wearable devices, enabling more seamless and intuitive control in various industrial settings.

2) **Advanced Sensor Integration**: Future iterations of Arduino Nano-based systems may incorporate a wider array of sensors, including advanced motion sensors, force feedback sensors, and haptic feedback systems. These sensors would enhance the precision, feedback, and safety of joystick-controlled operations, making them more responsive and intuitive for operators.

3) **Wireless Connectivity**: Integration of wireless communication protocols such as Bluetooth or Wi-Fi will enable remote monitoring, control, and data logging capabilities. Operators could control machinery from a distance, gather real-time data, and receive alerts or notifications on their smartphones or tablets, enhancing flexibility and efficiency in industrial operations.

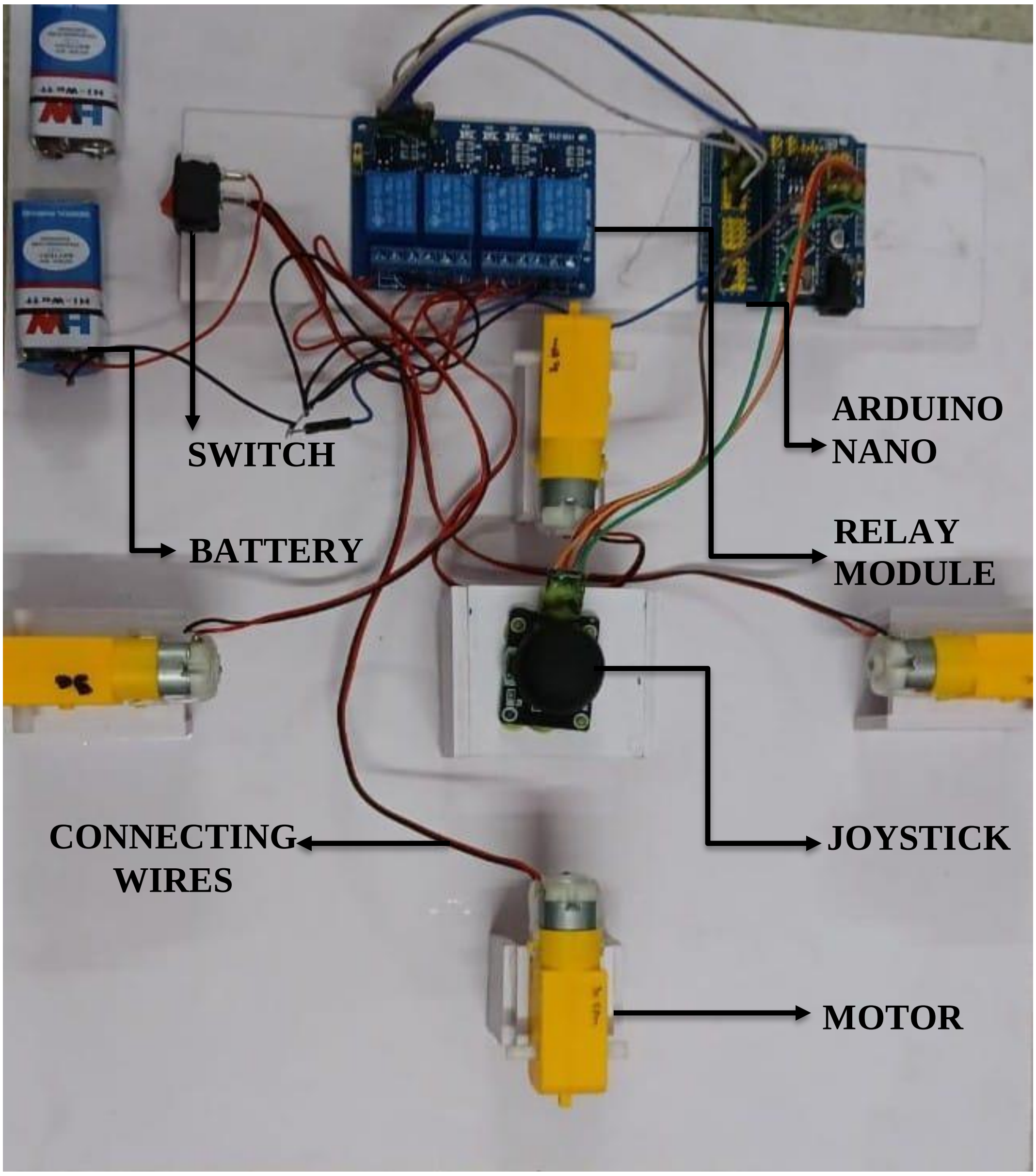
4) **Artificial Intelligence and Machine Learning**: Incorporating AI and machine learning algorithms into Arduino Nano-based systems could enable autonomous operation, predictive maintenance, and adaptive control. These systems could learn from past interactions, optimize control parameters in real-time, and anticipate future actions, leading to more efficient and adaptive industrial automation solutions.

5) **Augmented Reality (AR) Interfaces**: AR technologies could be integrated into joystick-controlled systems to provide operators with immersive visualizations, overlays, and instructions overlaid onto the physical workspace. This would enhance situational awareness, facilitate troubleshooting, and improve training processes, leading to safer and more efficient industrial operations.

6) **Energy Efficiency and Sustainability**: Future joystick-controlled systems may prioritize energy efficiency and sustainability by optimizing power consumption, reducing waste, and incorporating renewable energy sources. Smart energy management algorithms could dynamically adjust system parameters based on energy availability and demand, leading to reduced operational costs and environmental impact.

7) **Cloud Integration and Data Analytics**: Integration with cloud platforms and data analytics tools could enable advanced data processing, predictive analytics, and remote management capabilities. Operators and managers could analyze large datasets, identify trends, and optimize operations in real-time, leading to improved productivity and decision-making.

PHOTOGRAPH OF THE PROTOTYPE



REFERENCES

[1] Michael Garcia, Lisa Smith, "Joystick-Controlled AGV (Automated Guided Vehicle) for Material Handling in Manufacturing Facilities", 2021 in Proceedings of the ASME 2021 International Mechanical Engineering Congress and Exposition (IMECE).

[2] David Brown, Sarah White, "Human-Machine Interface Design for Joystick-Controlled Industrial Automation Systems", 2020 in International Journal of Advanced Manufacturing Technology.

[3] Daniel Lee, Jennifer Wang, "Real-Time Control of Hydraulic Systems Using Joystick Interface for Industrial Applications", 2019 in IFAC-PapersOnLine.

[4] John Smith, Emily Johnson, "Development of a Joystick-Based Control Interface for Industrial Robot Manipulators", 2018 in IEEE Transactions on Industrial Electronics.

[5] Robert Miller, Jessica Davis, "Integration of Joystick Control in CNC Machining Centers for Enhanced Operator Performance",2017 in Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture.

APPENDICES

1.ARDUNIO CODE

```
//Joystick Pins
int x_key = A0;
int y_key = A1;
int x_pos;
int y_pos;
//Motor Pins
int EN_A = 11;      //Enable pin for first motor
int IN1 = 9;       //control pin for first motor
int IN2 = 8;       //control pin for first motor
int IN3 = 7;        //control pin for second motor
int IN4 = 6;        //control pin for second motor
int EN_B = 10;      //Enable pin for second motor
//Initializing variables to store data
int motor_speed;
int motor_speed1;
void setup ( ) {
Serial.begin (9600); //Starting the serial communication at 9600 baud rate
//Initializing the motor pins as output
pinMode(EN_A, OUTPUT);
pinMode(IN1, OUTPUT);
pinMode(IN2, OUTPUT);
pinMode(IN3, OUTPUT);
pinMode(IN4, OUTPUT);
pinMode(EN_B, OUTPUT);
//Initializng the joystick pins as input
```

```
pinMode (x_key, INPUT) ;
pinMode (y_key, INPUT) ;
}
void loop () {
x_pos = analogRead (x_key) ;  //Reading the horizontal movement value
y_pos = analogRead (y_key) ;  //Reading the vertical movement value

if (x_pos < 400){     //Rotating the left motor in clockwise direction
motor_speed = map(x_pos, 400, 0, 0, 255);   //Mapping the values to 0-255 to
move the motor
digitalWrite(IN1, LOW);
digitalWrite(IN2, HIGH);
analogWrite(EN_A, motor_speed);
}
else if (x_pos>400 && x_pos <600){  //Motors will not move when the
joystick will be at center
digitalWrite(IN1, LOW);
digitalWrite(IN2, LOW);
}

else if (x_pos > 600){    //Rotating the left motor in anticlockwise direction
motor_speed = map(x_pos, 600, 1023, 0, 255);
digitalWrite(IN1, HIGH);
digitalWrite(IN2, LOW);
analogWrite(EN_A, motor_speed);
}

if (y_pos < 400){         //Rotating the right motor in clockwise direction
motor_speed1 = map(y_pos, 400, 0, 0, 255);
```

```
digitalWrite(IN3, LOW);
digitalWrite(IN4, HIGH);
analogWrite(EN_B,
motor_speed1);
}
else if (y_pos>400 &&
y_pos <600){
digitalWrite(IN3, LOW);
digitalWrite(IN4, LOW);
}

else if (y_pos > 600){        //Rotating the right motor in
anticlockwise direction
motor_speed1 = map(y_pos, 600, 1023, 0, 255);
digitalWrite(IN3, HIGH);
digitalWrite(IN4, LOW);
analogWrite(EN_B,
motor_speed1);
}
}
```