IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, April 2024

Object Detecting Robotic Eye utilizing Microcontroller

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Abstract: *This research paper explores a design for 3D printed robotic eye with the ability of object detection and movements in the direction of x-y axis. The movement of eye control by joysticks and the camera will capture live footage onscreen and detects the object. Understanding how characteristics like the restriction of eye orientations to a 2D manifold. Although earlier studies have addressed some ofthese problems, none have so far considered the full 3D complexity of ocular kinematics and* ***dynamics****.[1] Our designcontains a spherical eye actuated by four servo-motors and the movement of eye control by joysticks then the camera will capture live footage on screen and detects the object*

Keywords: 3D-printed, object detection, movements, x-y axis,joysticks, kinematics, dynamics

I. INTRODUCTION

In a world where the convergence of technology and creativity continually pushes the boundaries of what's possible, the project at hand represents an innovative fusion of mechatronics and surveillance technology. We are developing a robotic eye which is controlled by manually through its joysticks. This marks an intersection of advanced robotics and human-machine interaction.

This project introduces endeavour to design and construct a 3D- printed animatronic eye with the ability to respond by manually with a wireless camera for surveillance purposes.The project's genesis was rooted in a quest for exploration and learning within the realms of mechatronics, driven by the desire to create a visually captivating and responsive animatronic eye. This animatronic eye decide where it looks using a joystick, and its equipped with camera to capture what's happening around. The cool part is, it can identify objects or faces, making it not just a moving eye but also a helpful tool for recognizing things

II. AIM AND OBJECTIVE

The aim of a robotic eye is to replicate and simulate human vision, allowing machines to perceive and interpret visual information from the environment. This technology is often used in robotics, artificial intelligence, and computer vision to enable machines to understand and interact with the world through visual input, similar to how humans use their eyes.

The objective of a robotic eye is to replicate the functionality of the human eye, enabling machines to perceive and interpret visual information. This includes tasks such as image capture, recognition of objects and patterns, depth perception, and facilitating interactions with the environment through visual input. Robotic eyes are crucial components in various applications, including robotics, computer vision, and artificial intelligence, enhancing machines' ability to understand and respond to the visual world.

III. BACKGROUND

The robotic eye basically mechanics and motion characteristics that is used in robotic body applications now all around the globe. It uses it ability to detect the object and work with the same accuracy at any time anywhere, it is also more precise and does work fast it can be controlled via joysticks or manually. As a result, it has made its space in this world of competition it is nowadays.

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Arduino Nano Module:

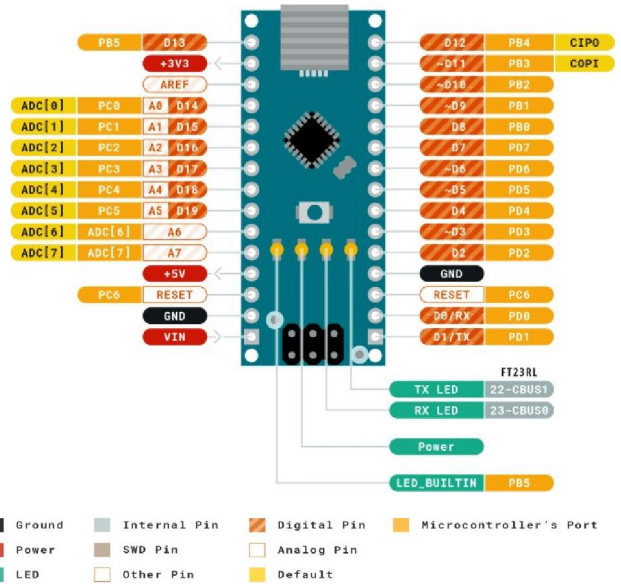

Figure 1. Arduino Nano Module

Arduino Nano is a small, complete, and breadboard-friendly development board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino UNO, but in a different package. It lacks only a DC power jack, and works with a Mini- B USB cable instead of a standard one. The connectivity is the same as the Arduino UNO board.[2]

LM2596 DC-DC Buck Converter Step Down Module:

Figure 2. LM2596 DC-DC Buck Converter Step Down Module

The LM2596 regulator is monolithic integrated circuit ideally suited for easy and convenient design of a step−down switching regulator (buck converter). It is capable of driving a 3.0 A load with excellent line and load regulation. This device is available in adjustable output version and it is internally compensated to minimize the number of external components to simplify the power supply design.

Since LM2596 converter is a switch−mode power supply, its efficiency is significantly higher in comparison with popular three−terminal linear regulators, especially with higher input voltages. The LM2596 operates at a switching frequency of 150 kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators.[3]

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Joystick Module:

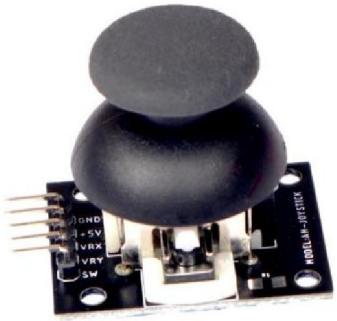

Figure 3. Joystick Module

Lots of robotic projects need a joystick. This module offers an affordable solution to that. The Joystick module is similar to analog joysticks found in gamepads. It is made by mounting two potentiometers at a 90 degrees angle. The potentiometers are connected to a short stick centered by springs. This module produces an output of around 2.5V from X and Y when it is in resting position. Moving the joystick will cause the output to vary from 0v to 5V depending on its direction. If you connect this module to a microcontroller, you can expect to read a value of around 512 in its resting position (expect small variations due to tiny imprecisions of the springs and mechanism) When you move the joystick you should see the values change from 0 to 1023 depending on its position.[4]

Servo motor:

Figure 4. Servo motor

Servo motor is a DC motor with a closed feedback system in which the position of its rotor will be communicated back to the control circuit in the servo motor. This motor consists of a DC motor, a set of gear, potentiometer and the control circuit. We use four SG90 servo motors to control the eye's movement.

USB Camera Module:

Figure 5. USB Camera Module

USB camera modules are designed with ease of use in mind. They can be connected to any device with a USB port, making it simple and quick to set up. With their small size, they can be easily transported from one location to another, providing users with a versatile solution that can be used in different environments. USB camera modules also offer

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high-quality imaging and performance. Equipped with advanced imaging technology, they are capable of producing high-resolution images and videos that are ideal for industrial and commercial applications such as quality control, inspection, and scientific imaging.

USB camera modules can be used for remote monitoring and teleconferencing purposes, due to their compact and portable design. They can be easily connected to a computer or other device and provide high-quality video and audio, making it an ideal solution for remote collaboration and communication[5]

IV. DESIGN METHODS

Materials and tools:

Material used in the design of hardware, among others:

- Arduino Nano : The Arduino Nano microcontroller serves as the brain of our projectt, responsible for data processing.
- Servo Motors: We use four SG90 servo motors to control the eye's movement, allowing it to pan and
- tilt realistically.
- Joysticks: It is used for to open the eye as well control the movements of eye.
- DC to DC Converter: Used for to deliver stable and efficient power from main power supply.
- Nut and Bolds: Various screws are used for assembling the 3D-printed parts and securing components.
- Jumper Cables: Jumper cables help connect the Arduino to the servo motors and other electronic components, facilitating communication.
- Pin Header: Pin headers are used to connect wires and components on the PCB board, ensuring a secure electrical connection.
- PLA Filament and 3D Printer: PLA filament is used as the material for 3D printing the eye's components.

Software:

The supporting software's used in our work:

- The Arduino IDE is used to create the program in the microcontroller.
- A Python is used for the function of Object Detection.

Hardware Design:

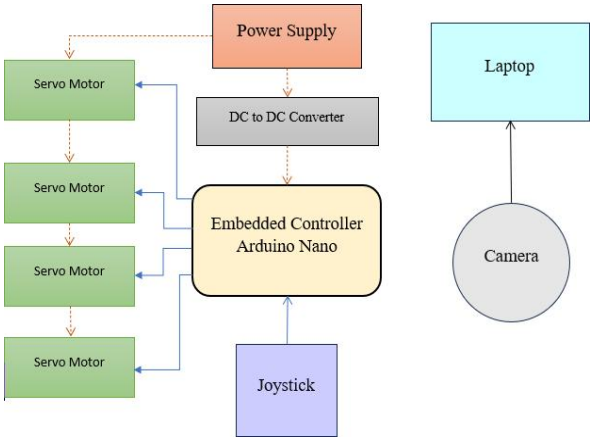

Figure 6. Block diagram of Object Detecting Robotic Eye

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V. RESULT

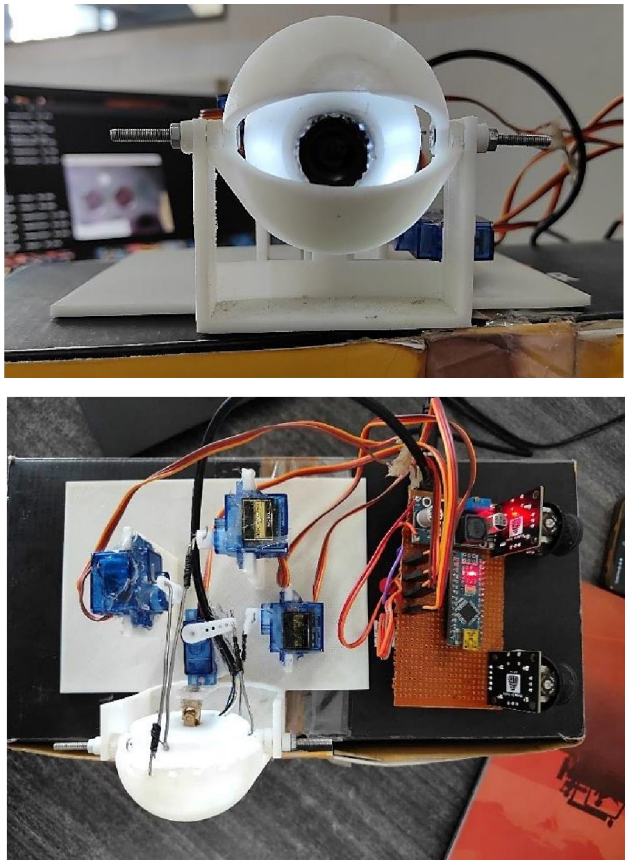

Figure 7. Actual Robotic Eye Produced

No.	Specification	Value
1	Height	75mm
2	Width	105mm
3	Length	150mm
4	Weight	250gm

Table 1. The Robot Specification

Design realization:

A Robotic eye of 4 motors, despite of its limitation such as its 3D printing but still it can detects given object perfectly and move in up-down and left-right direction.

Object Detection:

The camera which placed in eye structure will detects the objects at 1-2 meters away from eye. To perform object detection we use Python. By running the Python the camera will starts to detecting object front of it such as bottle, table, chair, person, dog, cat etc. and display on laptop screen

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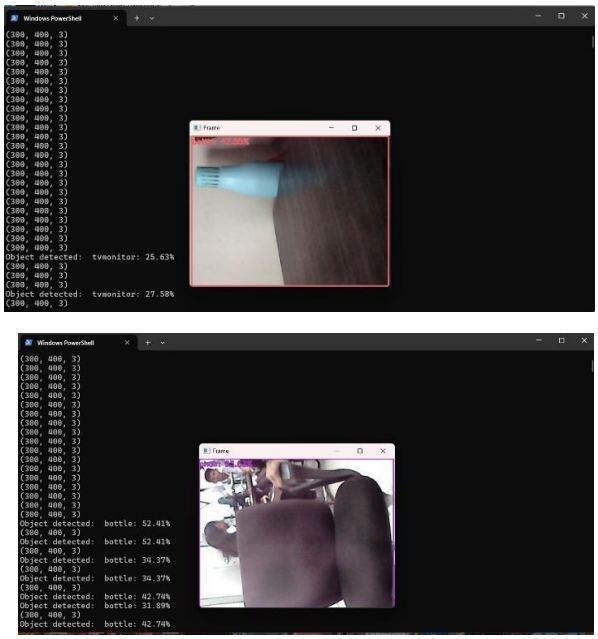

Figure 8. Object Detection

VI. CONCLUSION

The Object Detecting Robotic Eye has enable to perform the designed movement and object detection very well. Even though the robotic eye has only four motors still eye can move smoothly.

To expand the capabilities of the robotic eye by adding features such as adjustable focus, eyelid movement, and dynamic pupil dilation. These additions can enhance its versatility and use in various scenarios.

Also it can in corporate voice and sound recognition systems to allow the animatronic eye to respond to vocal commands or environmental sounds, further enhancing interactivity.

ACKNOWLEDGMENT

We would like to express our deepest gratitude to Mr. R.S.Solunke sir for their guidance and support throughout the duration of project. Also we thankful to our Head of the Department, Mrs.A.N.Dubey mam for their encouragement and valuable feedback. Together, we have achieved success in completing this project.

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