MOTION CONTROLLED COMPUTER USING ARDUINO

A PROJECT REPORT

submitted by

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BONAFIDE CERTIFICATE

Certified that this project report titled "**MOTION CONTROLLED COMPUTER USING ARDUINO"** is the bonafide work of "**SHIYAAM PRASAD V (210701321), YAASHISH G (210701317), YAR ZAR MIN (210701318)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

In recent days the automation in the domain of robotics motivates researchers to develop more flexible and simple operable machines. In the present work, the operations of computer or laptop's desktop functionalities are controlled through various hand gestures of human. In this system, a Human Machine Interface (HMI) system plays a key role in exchanging the data between computer and human. The current design is mainly involved with HMI system that is able to control the system applications such as volume offsetting, scroll vertical and horizontal, tab shifting etc., without using any mouse, keyboard, or joystick. This would be a great help for paralyzed people if they are able to control the system without any electronic gadget specified above. The system control with simple unique gestures of hands reduces the space between user and machine. In the present paper basic Arduino Uno is used to support the hand gesture-based system control.

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TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

As the technology tends to make human life easier and safer, our main aim is to reduce the effort of interaction with computers or laptops through the input devices using simple gestures as gesture-based interaction are becoming very popular both at workplace. As you are aware of motion of a robot controlled by gestures of the hand. Our project is kind of similar to that but here we use hand motion to control our personal computer. This work intends to develop a system which can recognize hand gestures which can be used as an input command to interact with the PC or laptop. One of the key areas which need to be looked at while developing such systems is the code implementation stage. In order to manage the work we shall also be using Python for the implementation of the code. We feel that if successfully meet our goals then we shall have contributed towards the future of natural gesture based interfaces, if only in a minimal way . Let's have a brief look into the project with all the working analysis and results we achieved.

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1.1Motivation

The motivation for the motion-controlled computer project stems from a desire to improve accessibility and usability in human-computer interaction. By developing a system that interprets hand gestures to control desktop functionalities, the project aims to provide an intuitive interface for individuals with disabilities, such as paralysis, who may struggle with traditional input devices like keyboards or mice. Additionally, the project seeks to explore innovative ways to interact with computers, offering a more natural and immersive user experience. Furthermore, by leveraging Arduino and Python technologies, the project aims to demonstrate the potential of combining hardware and software to create versatile and adaptable systems that can be customized to meet diverse user needs.

1.2 Objectives

Develop a motion-controlled system: Create a system that interprets hand gestures to control desktop functionalities, enabling users to interact with computers without traditional input devices.

Enhance accuracy and reliability: Fine-tune distance thresholds, implement noise-filtering techniques, and leverage machine learning algorithms to improve the system's accuracy in detecting and interpreting hand motions.

Enable adaptability and customization: Design the system to be adaptable to various gestures and customizable to meet diverse user needs, allowing for integration with additional functionalities or compatibility with different devices.

CHAPTER 2

LITERATURE REVIEW

The IEEE paper titled “Real Time Hand Gesture Recognition for Human Computer Interaction” is proposed by Rishabh Agrawal and Nikita Gupta[1] Most of the human computer interaction interfaces that are designed today require explicit instructions from the user in the form of keyboard taps or mouse clicks A novel method to recognize hand gestures for human computer interactions, using computer vision and image processing techniques, is proposed in this paper. However, this kind of input also raises issues that are not relevant with traditional input. On the user’s side, these problems are to learn, to remember and to accurately execute gestures user’s side, these problems are to learn, to remember and to accurately execute gestures.

The IEEE paper titled “Hand gesture recognition for human computer” is proposed by Meenakshi Panwar and Pawan Singh Mehra [2]. A hand gesture recognition system to provide a natural, innovative and modern way of non-verbal communication. It has a wide area of application in human computer interaction and sign language. The intention of this paper is to discuss a novel approach of hand gesture recognition based on detection of some shape-based features. These problems are to learn, to remember and to accurately execute gestures. The developer has to provide a system that correctly recognizes these gestures.

2.1Existing System

The existing system for this project focuses on developing a Human Machine Interface (HMI) that allows users to control computer or laptop desktop functionalities using hand gestures. By leveraging Arduino Uno technology, the system enables tasks such as adjusting volume, scrolling, and tab shifting without the need for traditional input devices like mice or keyboards. This hands-free approach not only enhances accessibility but also bridges the gap between users and machines, particularly benefiting individuals with disabilities such as paralysis.

2.1.1 Advantages of the existing system

Accessibility: The system enables individuals, especially those with disabilities like paralysis, to interact with computers or laptops using simple hand gestures, eliminating the need for conventional input devices.

Flexibility: Users can perform various desktop functionalities such as volume adjustment, scrolling, and tab shifting with ease, thanks to the intuitive hand gesture controls.

2.1.2 Drawbacks of the existing system

Limited Gesture Recognition: The system may struggle to accurately interpret complex or subtle hand gestures, potentially leading to errors or misinterpretations in user input.

Reliance on Hardware: While the system utilizes Arduino Uno for hand gesture recognition, it may be limited by the hardware's processing power and memory, restricting the range or complexity of supported gestures and functionalities.

2.1 Proposed System

In the existing motion-controlled system using Arduino and Python, there are several opportunities for enhancement and refinement. Firstly, to improve accuracy, we can fine-tune the distance thresholds in the Arduino code, ensuring precise detection of hand motions. Additionally, implementing a moving average or other filtering techniques can mitigate noise in sensor readings, further enhancing the reliability of the system. We leveraged the k-Nearest Neighbors (KNN) algorithm as a machine learning approach for gesture recognition.

2.2.1Advantages of the proposed system

Improved Accuracy: Fine-tuning distance thresholds and implementing noise-filtering techniques enhance the system's accuracy in detecting hand motions, ensuring precise recognition of gestures.

Robust Gesture Recognition: Utilizing the k-Nearest Neighbors (KNN) algorithm enables accurate classification of diverse hand movements, providing a reliable framework for interpreting and responding to gestures effectively.

CHAPTER 3

SYSTEM DESIGN

3.1Development Environment

3.1.1 Hardware Requirements

Arduino UNO

Ultrasonic sensor

USB cable

Jumper wires

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

Arduino UNO

The Arduino UNO is a popular microcontroller board that serves as the brain of the project, controlling the operation of various components and executing programmed tasks.

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Jumper wires

Jumper wires are used to establish connections between components on the sensor or between the sensor and Arduino UNO, facilitating the flow of electrical signals in the circuit.

Ultrasonic sensor

An ultrasonic sensor emits high-frequency sound waves and measures the time it takes for them to bounce back, enabling distance measurement without physical contact. These sensors are commonly used in robotics, automation, and proximity detection applications due to their accuracy and non-invasive nature**.**

USB cable

A USB cable connects a laptop to an Arduino Uno, facilitating data transfer and power supply between the two devices. It serves as a reliable and commonly used interface for programming and communication with the Arduino Uno board.

3.1.1Software Requirements

- Arduino IDE
- Python IDLE (3.11)

CHAPTER 4

PROJECT DESCRIPTION

This project integrates Arduino and Python to create a hand motion-controlled system, refining accuracy and reliability. By adjusting distance thresholds and employing noise-filtering methods, the system ensures precise detection of hand gestures. The utilization of the k-Nearest Neighbors (KNN) algorithm enhances gesture recognition, enabling the classification of diverse hand movements based on a training dataset. This approach not only enhances the system's ability to interpret gestures accurately but also fosters adaptability and customization.

4.1 SYSTEM ARCHITECTURE

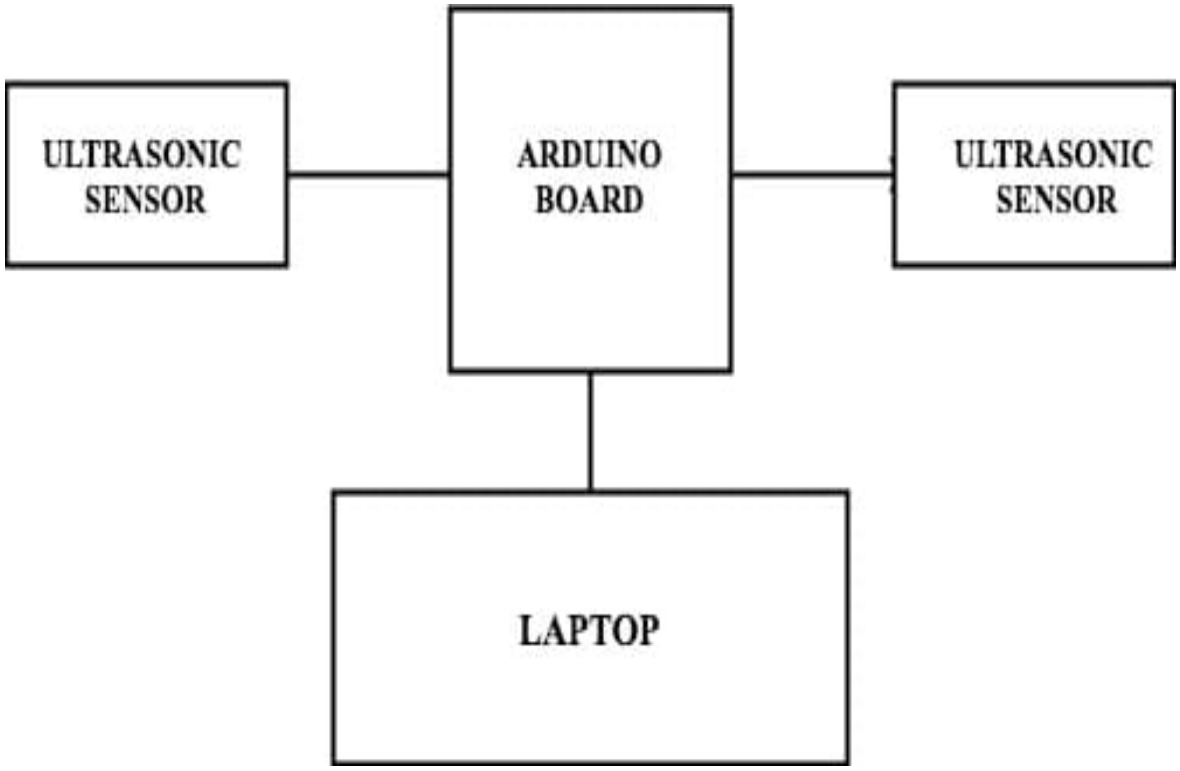

Fig 4.1 System Architecture

4.2 METHODOLOGY

The methodology for developing a motion-controlled computer using Arduino begins with hardware setup, connecting an ultrasonic sensor to the Arduino board for distance measurement. Programming the Arduino involves writing code to interpret hand gestures based on sensor data, fine-tuning thresholds, and implementing filtering techniques for accuracy enhancement. Simultaneously, the Python environment is established on the computer for USB communication with Arduino, processing incoming data, and executing gesture recognition using machine learning algorithms such as k-Nearest Neighbors (KNN). A training phase is crucial, where a dataset of known hand gestures trains the KNN algorithm for accurate classification.

CHAPTER 5

RESULTS AND DISCUSSION

The results of the motion-controlled computer project using Arduino and Python demonstrate promising outcomes in terms of accuracy, usability, and adaptability. Through fine-tuning distance thresholds and implementing noise-filtering techniques, the system achieves precise detection of hand motions, enhancing overall accuracy. Leveraging the k-Nearest Neighbors (KNN) algorithm for gesture recognition facilitates robust classification of diverse hand movements, resulting in accurate interpretation and response. Testing reveals reliable performance across various gestures, indicating the system's effectiveness in real-world applications. Additionally, the system's adaptability allows for customization and expansion, enabling integration with additional functionalities or compatibility with different devices in the future.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1Conclusion

The motion-controlled computer project utilizing Arduino technology has successfully demonstrated the potential for intuitive and hands-free computer interaction. It is one of the easiest ways of interaction between humans and computers. It is a cost-effective model that is only based on Arduino UNO and ultrasonic sensors. The Python IDE allows seamless integration with Arduino UNO to achieve different processing and controlling methods for creating new gesture control solutions. Additional gesture recognition opportunities exist in medical applications where, for health and safety reasons, a nurse or doctor may not be able to touch a display or trackpad but still needs to control a system. In other cases, the medical professional may not be within reach of the display yet still needs to manipulate the content being shown on the display. Appropriate gestures, such as hand swipes or using a finger as a virtual mouse, are a safer and faster way to control the device.

6.2Future Work

In future iterations of the motion-controlled computer project, potential advancements could include incorporating advanced gesture recognition algorithms, exploring 3D gesture control using depth-sensing technologies, integrating machine learning for personalized and adaptive gesture recognition, and enhancing the system's overall usability through multimodal interaction. Further improvements might involve real-time feedback mechanisms, customizable gestures, and seamless integration with specific applications or software. Additionally, efforts could be directed towards optimizing wireless communication, exploring wearable integration for a more portable experience, and implementing gesture analytics for continuous refinement of recognition algorithms based on user interactions.

APPENDIX

SOFTWARE INSTALLATION

Arduino IDE

To run and mount code on the Arduino NANO, we need to first install the Arduino IDE.

After running the code successfully, mount it.

Sample code

```
import serial #Serial imported for Serial communication
import time #Required to use delay functions
import pyautogui

ArduinoSerial = serial.Serial('COM3',9600) #Create Serial port object called arduinoSerialData
time.sleep(2) #wait for 2 seconds for the communication to get established

while 1:
   incoming = str (ArduinoSerial.readline()) #read the serial data and print it as line
   print( incoming)

\if 'back' in incoming:
      pyautogui.press('right')

   if 'Vup' in incoming:
      pyautogui.hotkey('ctrl', 'up')

   if 'Vdn' in incoming:
      pyautogui.hotkey('ctrl', 'down')

   if 'next' in incoming:
      pyautogui.press('left')

   incoming = "";
```

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