IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Air Mouse Using Arduino Leonardo

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Abstract*—*Human-computer interaction has evolved significantly with the advancement of motion sensing technologies, enabling more intuitive and flexible control methods. Traditional computer mice require a flat surface and limit user mobility. This paper presents the design and implementation of a cost-effective air mouse system using an Arduino Leonardo and an MPU6050 motion sensor. The system continuously tracks hand movements by detecting changes in acceleration and orientation. When motion is detected, the Arduino processes the sensor data and translates it into cursor movement on the computer screen using built-in Human Interface Device (HID) functionality. Additional controls such as clicking actions can be implemented using buttons or gesture-based inputs. The system operates in real-time without the need for external drivers and provides a seamless user experience. The use of simple and affordable components makes the system easy to implement, portable, and energy efficient. The proposed system is reliable, low-cost, and suitable for applications such as presentations, gaming, and assistive technologies.

I. INTRODUCTION

Human-computer interaction plays a vital role in modern digital systems, especially in applications where ease of use and flexibility are essential. Traditional input devices such as wired or wireless mice require a flat surface for operation, which limits user mobility and convenience. With the growing demand for more intuitive and portable interaction methods, there is a need for innovative solutions that allow users to control computers in a more natural and efficient way.

Conventional pointing devices depend on physical movement across a surface, which may not be suitable in all environments such as presentations, virtual reality setups, or situations where space is limited. Additionally, these devices can be inconvenient for users who require greater freedom of movement or hands-free interaction. As a result, motion-based control systems have gained attention as an alternative approach to human-computer interaction.

With advancements in embedded systems and sensor technology, microcontrollers such as Arduino have made it possible to develop low-cost and efficient motion-based devices. The Arduino Leonardo is particularly suitable for such applications due to its built-in Human Interface Device (HID) capability, allowing it to function directly as a mouse when connected to a computer. Furthermore, motion sensors like the MPU6050, which combines an accelerometer and a gyroscope, enable accurate detection of hand movements and orientation.

This paper presents the design and implementation of an air mouse system using an Arduino Leonardo and an MPU6050 sensor. The system continuously tracks hand movements in free space and converts them into cursor movement on a computer screen. The Arduino processes the sensor data and sends control signals to the computer, enabling real-time interaction. Additional features such as clicking and scrolling can be implemented using buttons or gesture-based controls.

The proposed system is cost-effective, portable, and easy to implement. It eliminates the need for a physical surface and enhances user flexibility. The system is suitable for applications such as presentations, gaming, assistive technologies, and advanced human-computer interaction systems. By combining simple hardware components with motion sensing technology, the system provides a practical and efficient alternative to traditional input devices.

II. LITERATURE REVIEW

Several research works have been carried out in the field of motion-controlled devices and human-computer interaction using embedded systems.

A basic air mouse system using an accelerometer and microcontroller was proposed in [1], where hand movements were detected and converted into cursor motion. The system was simple and cost-effective but lacked precision due to the absence of gyroscope-based orientation tracking.

An Arduino-based gesture control system was presented in [2], which utilized motion sensors to control cursor movement and perform click operations. The system demonstrated reli- able performance; however, it suffered from limited accuracy and occasional delay in response.

In [3], a motion-controlled mouse using an inertial measure- ment unit (IMU) was developed to improve tracking accuracy. The integration of both accelerometer and gyroscope enhanced performance, but the system required complex data processing and calibration.

A wireless air mouse system using Bluetooth communica- tion was introduced in [4], allowing users to control devices remotely. While the system improved portability and user con- venience, it increased power consumption and overall system complexity.

In [5], a gesture recognition system using machine learning techniques was proposed for air mouse applications. The sys- tem enabled advanced features such as gesture-based clicking

and scrolling, but it required higher computational resources and training data.

Another system based on Arduino Leonardo was presented in [6], where the microcontroller acted as a Human Interface Device (HID) to emulate a mouse. The system provided direct USB communication without additional drivers, but its performance depended heavily on sensor calibration and noise filtering.

A low-cost motion tracking system using MPU6050 was proposed in [7], focusing on improving accuracy through sensor fusion techniques. Although the system reduced drift errors, it required careful tuning and increased implementation complexity.

Based on the limitations of existing systems, the proposed system focuses on developing a simple, low-cost, and efficient air mouse using Arduino Leonardo and MPU6050 sensor. The system provides real-time cursor control using hand gestures without requiring complex algorithms or additional communication modules, making it suitable for everyday applications such as presentations, gaming, and assistive technologies.

III. PROPOSED SYSTEM

With the increasing demand for flexible and intuitive human-computer interaction, motion-based input devices have gained significant importance. To address the limitations of traditional mice, an air mouse system using Arduino Leonardo and an MPU6050 motion sensor is proposed. The system is designed to track hand movements in free space and convert them into cursor movements on a computer screen, providing a more natural and convenient user experience.

The proposed system consists of an Arduino Leonardo microcontroller, MPU6050 sensor (accelerometer and gyroscope), push buttons for click operations, connecting wires, and a USB interface for communication with the computer. The MPU6050 sensor is mounted on the user's hand or a handheld module, where it continuously detects motion and orientation in terms of acceleration and angular velocity.

The sensor sends motion data to the Arduino Leonardo through I2C communication. The microcontroller processes this data and maps it to cursor movement along the X and Y axes. When the user moves their hand in the air, the Arduino interprets the motion and moves the cursor accordingly on the screen. Push buttons or predefined gestures are used to perform actions such as left-click, right-click, and scrolling.

When motion is detected, the Arduino calculates the change in position and sends corresponding commands to the computer using its built-in Human Interface Device (HID) capability. The cursor moves in real-time based on hand gestures. When there is no movement, the cursor remains stable, ensuring controlled operation.

The system operates automatically without requiring additional drivers or complex setup. It provides a smooth and responsive user experience while maintaining low cost and simplicity. The use of Arduino Leonardo enables direct USB communication, making the system easy to implement and compatible with most computers.

Fig. 1 shows the block diagram of the proposed air mouse system. The system integrates motion sensing, data processing, and cursor control mechanisms to provide an efficient and cost-effective solution suitable for applications such as presentations, gaming, and assistive technologies.

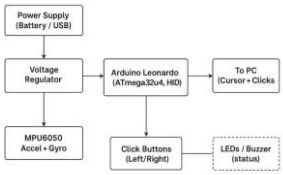

Fig. 1. Functional Block Diagram

IV. WORKING PROCESS

The working of the proposed air mouse system is based on continuous tracking of hand movements using a motion sensor and translating these movements into cursor control on a computer screen. Fig. 2 shows the flowchart of the system operation.

Initially, when the system is powered on through the USB connection, the Arduino Leonardo microcontroller initializes all the connected components such as the MPU6050 sensor and push buttons. After initialization, the system enters a continuous motion tracking mode.

The MPU6050 sensor continuously detects changes in acceleration and angular orientation of the user's hand. When the user moves their hand in the air, the sensor measures the motion in terms of X and Y axis values and sends this data to the Arduino Leonardo through I2C communication.

The Arduino reads the sensor data and processes it to determine the direction and magnitude of movement. Based on the calculated values, the Arduino generates corresponding cursor movement commands. Using its built-in Human Interface Device (HID) functionality, the Arduino sends these commands to the computer, causing the cursor to move in real time according to the hand motion.

When the user presses a push button or performs a predefined gesture, the Arduino interprets this input as a mouse action such as left-click, right-click, or scrolling. The corresponding command is then sent to the computer to perform the required operation.

If no motion is detected, the sensor outputs stable values, and the Arduino keeps the cursor stationary, ensuring precise control. The system continuously repeats this process, allowing smooth and uninterrupted interaction.

This automated operation eliminates the need for a physical surface and provides a flexible and efficient way to control a computer. The system ensures real-time response and reliable performance, making it suitable for applications such as presentations, gaming, and assistive technologies.

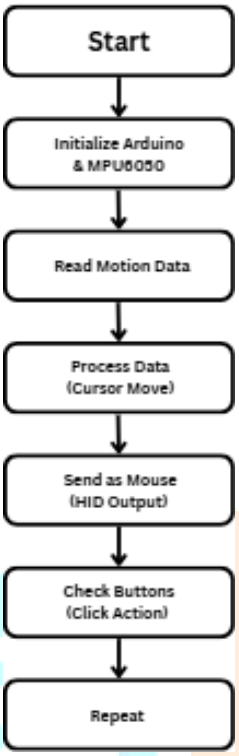

Fig. 2. Flow Chart Of Air Mouse

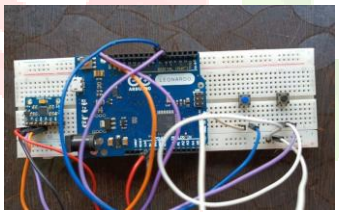

Fig. 3. Circuit Connections

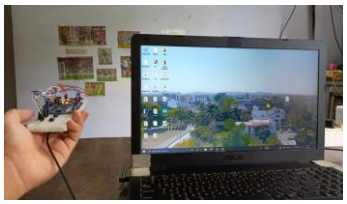

Fig. 4. Working Model

V. RESULT

The proposed air mouse system was implemented and tested successfully under real-time conditions. The system effectively tracked hand movements using the MPU6050 sensor and translated them into cursor movement on the computer screen. The Arduino Leonardo processed the motion data accurately and enabled smooth communication with the computer.

During testing, it was observed that the cursor responded to hand movements in real time with minimal delay. Tilting the sensor in different directions resulted in corresponding cursor movement along the X and Y axes. The response was stable and consistent under normal operating conditions.

The buttons connected to the Arduino successfully performed mouse click operations such as left click and right click. Each button press generated the correct input without any noticeable lag, ensuring proper interaction with the system.

The system demonstrated reliable performance with good sensitivity and accuracy for basic cursor control. It was found to be suitable for short-range use and applications such as presentations, basic navigation, and interactive control.

Overall, the results confirm that the proposed air mouse system is efficient, cost-effective, and easy to implement. It provides a practical alternative to traditional input devices by enabling gesture-based control without the need for a physical mouse.

VI. CONCLUSION

The Arduino-based air mouse system presented in this project provides an effective solution for gesture-based computer control using simple and low-cost components. The system successfully tracks hand movements using the MPU6050 sensor and converts them into real-time cursor movement on the screen, enabling an interactive user experience.

The Arduino Leonardo efficiently processes the motion data and communicates with the computer as a Human Interface Device, ensuring smooth and reliable performance. The integration of buttons for click operations further enhances the usability of the system.

The proposed system is easy to implement, portable, and requires minimal maintenance. It operates effectively without the need for complex hardware or external drivers, making it suitable for various applications such as presentations, gaming, and basic computer navigation.

Overall, the system is cost-effective, user-friendly, and demonstrates how motion sensing technology can be utilized to create innovative alternatives to traditional input devices. The project highlights the practical application of embedded systems in developing modern, interactive solutions.

VII. REFERENCE

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