PROJECT REPORT

COURSE:
HUMAN COMPUTER INTERACTION
Section:-B
Group:-B5

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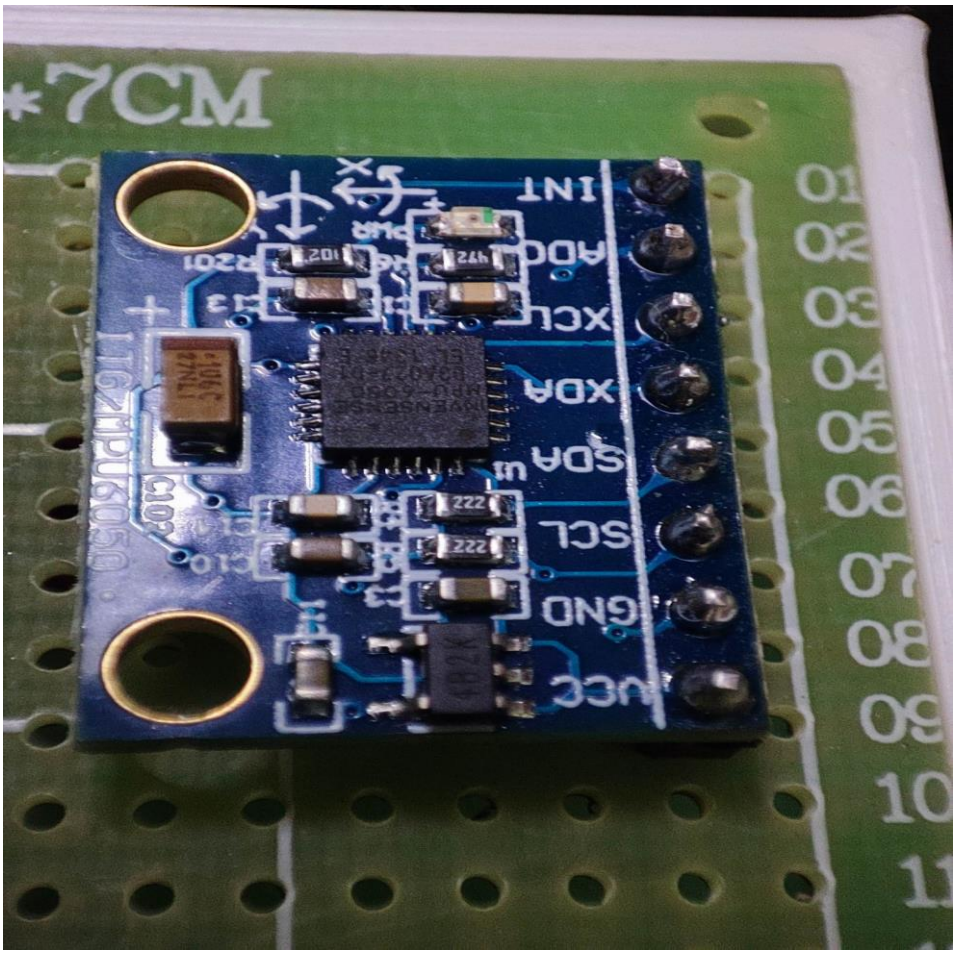
Introduction:

The purpose of this report is to document in detail the development of a gesture-based game controller using an Arduino Nano and an accelerometer as a two-axis gyro system. The project was undertaken as part of the course Human-Computer Interaction, with the aim of creating a more intuitive and user-friendly game controller that allows for natural movement and enhances the gaming experience. In this report, we will provide a comprehensive overview of the background study, implementation planning, circuit design, code design, testing, and results of the project. We will also discuss our findings, analysis, and recommendations for future work.

❑ Project Background:

- **Identification of problem:-**Traditional game controllers can be difficult to use and limit the user's movement. This can lead to discomfort and even injury. There was a need for a more intuitive and user-friendly game controller that allows for natural movement. The lack of natural movement in traditional game controllers also reduces the level of immersion in games, which can negatively affect the overall gaming experience. To address this problem, we conducted a thorough study of different types of input devices used in gaming such as joysticks, gamepads, and motion-based controllers. We also studied the use of accelerometers and gyroscopes as input devices for motion-based controls. Research showed that motion-based controllers provide a more immersive gaming experience by allowing players to move their bodies naturally, resulting in better gameplay and physical well-being.
- **Background study:-**Before implementing the project we have to pass through a background study of different components .which is described below.

- Accelerometer: An accelerometer is a sensor that measures acceleration. It can detect changes in velocity along one or more axes and is commonly used in mobile devices for detecting orientation and tilting. In our project, we used an accelerometer as a two-axis gyro system to detect the movement of the hand. By mounting the accelerometer on a glove, we were able to capture the movement of the hand accurately and translate it into control signals for the game console.



- Arduino Nano: Arduino Nano is a small, compact board based on the ATmega328P microcontroller. It has 14 digital input/output pins and 8 analog input pins. The board is designed to be used with breadboards and is compatible with most shields designed for the

Arduino Uno. Its compact size made it an ideal choice for our project, as we needed a small form factor that could easily fit onto a glove.

- Adafruit LSM9DS1 library: We used the Adafruit LSM9DS1 library to interface with the accelerometer. The library provides easy-to-use functions for reading data from the accelerometer and gyroscope. It works with various Arduino boards, including the Arduino Uno, Leonardo, and Mega. The library also provides calibration functions to ensure accurate readings, which was crucial for our project since even minor errors in the accelerometer readings could result in inaccurate control signals.

➢ **Goals:-**The goals of the project were to design and develop a gesture-based game controller using an Arduino Nano and an accelerometer as a two-axis gyro system. The aim was to create a more intuitive and user-friendly game controller that allows for natural movement and enhances the gaming experience. The project also aimed to demonstrate the feasibility of using accelerometers as input devices for motion-based controls and to provide valuable insights into the field of Human-Computer Interaction.

❑ Methodology:

➢ **Method and tools:-**

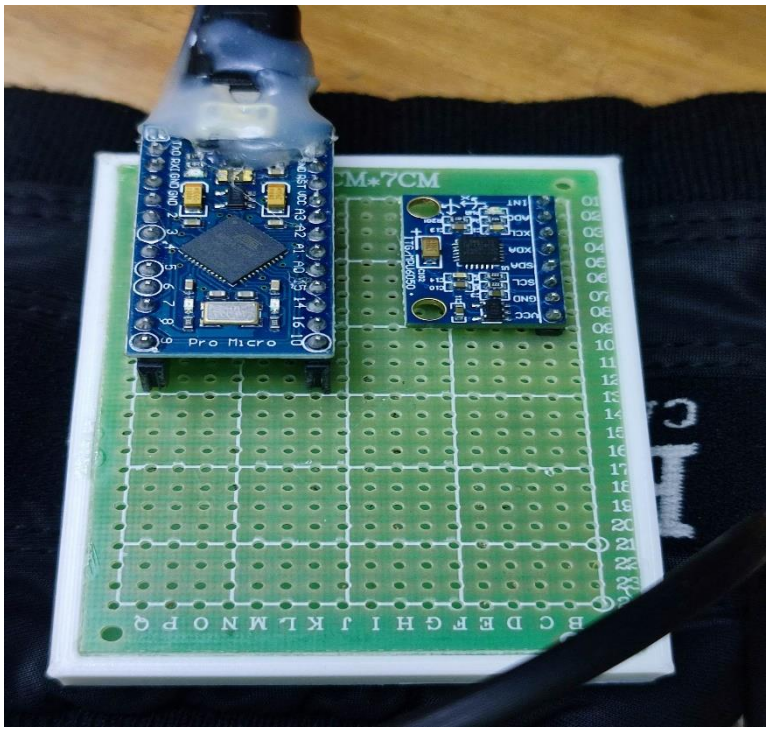
1. Arduino IDE: This is an integrated development environment (IDE) used to program the Arduino boards. It was used to write, compile, and upload the code for the project.
2. Adafruit LSM9DS1 Library: This library was used to interface with the accelerometer. It provides easy-to-use functions for reading data from the accelerometer and gyroscope.
3. Visor Board: The visor board was used as a platform to mount the Arduino Nano and the accelerometer, allowing for easy integration with the glove.
4. Serial Monitor: The Serial Monitor is a tool in the Arduino IDE that displays text data sent from the microcontroller over the serial port. It was used to observe the readings from the accelerometer during testing.
5. Wires: Various wires were used to connect the components of the circuit together.

Other tools and materials may have also been used such as soldering equipment, heat shrink tubing, and adhesive tapes to secure the components and wires in place.

- **Implementation Planning:** To implement our project, we first needed to design the circuit and write the code to control the Arduino Nano. We then had to calibrate the accelerometer and perform some initial testing to ensure that it was working correctly. The implementation planning process involved several stages, including brainstorming, prototyping, and iterative testing.

- **Implementation:-**

- Circuit Design: Our circuit consisted of an Arduino Nano, an accelerometer, and wires for connecting the two components. We also used a breadboard for prototyping purposes. To design the circuit, we consulted the datasheet for the accelerometer and followed the recommended wiring diagram provided by the manufacturer. We also added pull-up resistors to the I2C lines to ensure stable communication between the Arduino Nano and the accelerometer.



- Code Design: Our code was written in C++ using the Arduino IDE. We first initialized the accelerometer and enabled the necessary features such as the gyroscope and accelerometer. We then used the library functions to read the acceleration values along the X and Y axes and mapped them to a range suitable for controlling the game. Finally, we sent the control signals to the game console using a wired connection. The code was designed to be modular and easy to modify, allowing for easy expansion of the controller's functionality.

- Testing: After designing the circuit and writing the code, we assembled the hardware and tested the accelerometer. The testing involved moving the glove in different directions and observing the readings on the serial monitor. We also tested the controller with various games to ensure that it worked correctly. During the testing phase, we identified several issues with the controller, including noise in the accelerometer readings and latency issues with the game console. We addressed these issues through iterative testing and modifications to the code.

- **Result:** The final product was a functional prototype of a gesture-based game controller that allowed for natural, intuitive movement. The accelerometer worked well as a two-axis gyro system and provided accurate readings. The controller was able to control various games, including racing games. Users found the controller to be intuitive and easy to use, providing a more immersive gaming experience than traditional game controllers.

Discussions:

- **Finding:-**Our project successfully demonstrated the feasibility of using accelerometers as input devices for motion-based gaming controls. By mounting the accelerometer on a glove, we were able to capture hand movements accurately, translating them into control signals for the game console. We found that using an accelerometer as a two-axis gyro system provided a more natural and intuitive way of controlling games compared to traditional game controllers. The glove-mounted accelerometer also allowed for greater mobility, allowing users to move freely without being restricted by wires or bulky controllers.
- **Analysis:-**Overall, our project was successful in meeting our goals. The gesture-based controller we created was intuitive to use and enhanced the gaming experience by allowing for more natural movement. The Arduino Nano was the perfect platform for our project due to its compact size and versatility. We were able to interface with the accelerometer using the Adafruit LSM9DS1 library, which provided easy-to-use functions for reading data from the accelerometer and gyroscope. During the testing phase, we encountered several issues such as noise in the accelerometer readings and latency issues with the game console. However, we addressed these issues through iterative testing and modifications to the code, resulting in a functional prototype that met our design requirements.

❑ Conclusion:

- **Recommendation:-**There are several areas of future work that can be explored to build upon our project. Firstly, the addition of more sensors such as flex sensors or pressure sensors can provide more nuanced control options for the user. This would allow for a wider range of movements to be detected, resulting in a more immersive gaming experience. Additionally, exploring wireless connectivity options such as Bluetooth or Wi-Fi can further enhance the mobility and flexibility of the controller, allowing users to move freely without being restricted by wires.

  Another area of future work is the integration of machine learning algorithms to train the controller to recognize specific gestures and movements. This would allow the controller to adapt to individual user preferences and provide personalized control options. Machine learning could also improve the accuracy of the accelerometer readings, reducing noise and improving overall performance.

  Another potential avenue for future work is the development of a mobile app that allows users to customize their controller settings, view their performance metrics, and access additional features. This would provide users with greater control over their gaming experience and could potentially lead to the creation of an entire ecosystem of gesture-based controllers and games.
- **Conclusion:-**In conclusion, our project successfully demonstrated the feasibility of using an accelerometer as a two-axis gyro system for a gesture-based game controller. By mounting the accelerometer on a glove, we were able to capture hand movements accurately, providing a more natural and intuitive way of controlling games. The project showcased the potential of human-computer interaction and provided valuable insights into the development of motion-based gaming controls. Overall, this project was a great learning experience and provided valuable knowledge on the integration of hardware and software, as well as user-centered design principles. We hope that our work inspires further innovation in the field of gaming technology.