Robot Controller through Gestures

Team 41

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Introduction

Traditional Robot Controller

❌ Unresponsive Enough
❌ Not Easy to Use
❌ Unengaging

Can we have a cooler and more intuitive tool?
No Problem!
Objective
The position and orientation of fingers and palm can be collected through IMUs.

Hand movements and gestures can be translated to robot control actions respectively.

Users can get feedback through the glove.
Design
Project Overview

Subsystems

- Human Positioning System
- Gesture Control System
- Robot Feedback System
HEADING


Block Diagram
Human Positioning System

Fig. Gesture data collected from IMUs and sent to PC through Bluetooth

**Euler Angles**: Roll, Pitch, Yaw, in degrees

**Quaternions**: Q0, Q1, Q2, Q3

**Acceleration**: AX, AY, AZ, in m/s^2
Gesture Control System

- Using L2 algorithm to recognize gestures
- Translates gestures into robot commands
- Sends commands to robot via Bluetooth
0) Prerecord Gestures

Fig. Principles of L2 Algorithm
1) Get quaternions

Fig. Principles of L2 Algorithm
2) Calculate geodesic distance

Fig. Principles of L2 Algorithm
3) **Concatenate into one vector**

Fig. Principles of L2 Algorithm
More About L2 Algorithm

4) Compute the L2 distance

Fig. Principles of L2 Algorithm
5) Predict the gesture

![Graph: L2 error when doing different gestures](image)

*Note: Gesture -1 means no prediction*

**Fig. Example of L2 Algorithm in Operation**
Example of Saved Gestures

- **Hold** (Gesture 0)
- **Chassis** (Gesture 1)
- **Gimbal** (Gesture 2)
- **Shoot** (Gesture 3)
More About L2 Algorithm

Example output of software running on the PC

Fig. Examples of L2 Algorithm in Operation

Note: Threshold: 4, Prediction 404 means no prediction
Feedbacks include:

- Controller operating status
- Bluetooth connection status
- Messages from robot
- Possible warnings and errors

Feedback will be displayed through:

- LED
- Vibration motor
- Buzzer
- Display
More About Display

- Showing System Information
- Create Config Files Onboard
- Showing Operation Status
- Manage Config Files Onboard
# Functionality & Instruction Set

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold</td>
<td>Stop all action</td>
</tr>
<tr>
<td>Chassis</td>
<td>Move forward or back</td>
</tr>
<tr>
<td></td>
<td>Turn left or right</td>
</tr>
<tr>
<td></td>
<td>Rotate clockwise or counter clockwise</td>
</tr>
<tr>
<td>Gimbal</td>
<td>Move up or down</td>
</tr>
<tr>
<td></td>
<td>Move left or right</td>
</tr>
<tr>
<td>Shooter</td>
<td>Shoot</td>
</tr>
</tbody>
</table>

![Robot Image](image)
Conclusion
**Successes**

- Controller is fully functional.
- Also universal and customizable.
- We make use of the IMUs and identify gestures with high accuracy.

**Challenges**

- Bluetooth connection is unstable.
- Readings from IMUs are greatly influenced by the magnetic field of surrounding environment.
- Drawing the PCB board according to our needs.
Future Work

1. Remove intermediate PC
2. Build a UI for recording more gestures
3. Revise the gesture recognition algorithm
4. Reduce magnetic interference
5. Extend battery life
6. Tidier exterior design
The End