Tangible User Interfaces for Multi-Touch Surfaces

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Objectives:
1) Design and prototype a physical controller that can be used as a tangible user interface.
2) Create an engaging application demonstrating the benefits of a tangible interface.

Components:
- Arduino Uno 16MHz / 32kB
- Bluetooth Module 57600 baud
- 3-Axis Accelerometer +/- 3g
- Battery Pack 6v

Controller Functions
- Collect data from accelerometers
- Generate packet containing timing, acceleration, and controller identification
- Interpret requests and transmits either a packet containing timing and data or controller properties

Process Data
- Receive data request from game
- Collect data from accelerometers
- Compare the current reading to threshold readings
- Sends the game an updated velocity

Application Design Properties
- Initial connection with controllers transmits controller readings to determine threshold values to combat jitter.
- Velocities are applied based on the tilting severity of the controller, the farther the tilt the faster the movement.
- The game stores all the data received by the controller in file in order to do post processing analysis with MATLAB

AirHockeyGame
Built with XNA, an API to the DirectX graphics system, this class forms the core of the game, handling communication between the PhysicsEngine, SceneRenderer, and MenuSystem classes.

SceneRenderer
Handles insertion, deletion, and rendering of GameObjects.

GameObject
A base class which holds the information needed for rendering and physics processing

Camera
Converts 3D game coordinates to 2D screen coordinates

PhysicsEngine
Calculates changes in velocity and position of game objects during collisions. Supports elastic collisions of more than 50 unique objects simultaneously.

Controller
Creates a thread to communicate with the controller via the Serial Module interface.

Serial Module
Provides an interface to the Bluetooth module.

Interrupt driven requests are capable of reading and transmitting a new value with T_s = 15 ms

Plot of X Acceleration with Respect to Time

Plot of Y Acceleration with Respect to Time