Technical Layout Specification: OrbiTouch-Inspired Virtual Chorded Keyboard

1. System Overview and Input Logic

Mission Statement

The objective of this Android-based input system is to eliminate the fine motor skill dependencies inherent in traditional QWERTY layouts by synthesizing a high-level gesture-based interface. Grounded in the "Keybowl" architecture, the system provides an ergonomic alternative that circumvents the requirement for discrete finger strikes, making digital communication accessible to individuals with physical motor impairments and reducing cognitive search complexity for users with cognitive disabilities, such as autism.

Dual-Dome Control Architecture

The input subsystem is required to interrupt and process simultaneous virtual joystick gestures, translating them into alphanumeric output through a two-part virtual interface:

- **Left Dome (Directional Group):** Functions as the primary character set activator. It consists of 8 discrete directional positions arranged in 45-degree sectors (Up, Down, Left, Right, and four diagonal orientations).
- **Right Dome (Color-Coded Selector):** Functions as the specific character selector. This dome is divided into 8 color-coded zones which designate the specific character to be output from the group currently activated by the Left Dome.

Chording Definition

In this architecture, "chorded input" refers to the generation of a single character output through the simultaneous, coordinated movement of both virtual domes. Character output is only triggered when both joysticks satisfy the angular threshold and reach the actuation zone, ensuring a clear motor-perceptual code for the user.

2. Biomechanical and Ergonomic Foundations

The system moves away from the "finger-striking" model to prevent the repetitive tendon friction that leads to Carpal Tunnel Syndrome (CTS). By relocating the force required for input to larger muscle groups in the arm and shoulder, the system preserves the integrity of the median nerve and wrist structures.

Comparison of Physical Impact: Standard QWERTY vs. Keybowl/OrbiTouch

Metric,Standard QWERTY,Keybowl/OrbiTouch
Finger Movement,Constant dynamic striking/reaching,Eliminated (Fingers remain static)
Wrist Flexion/Extension,High-frequency repetitive strain,82.5% Average Reduction
Ulnar/Radial Plane Movement,Constant lateral deviation,58% Average Reduction
Actuation Force Requirement,Varies by switch type,0.8 Newtons (Calibrated for relaxed finger weight)

Muscle Work Distribution,Dynamic finger work/Static forearm work,Relocated to large muscle groups (Arm/Shoulder)

Static vs. Dynamic Muscle Work

Traditional typing creates "motoric incongruities" where the fingers perform high-intensity dynamic work while the forearms maintain fatiguing static postures. The Keybowl architecture shifts this burden, using lateral hand and arm motions to provide input. This utilizes proprioceptive information from larger joints, which are more resilient to fatigue than the small extensor muscle groups of the fingers.

3. Layout Mode I: Accessibility (Logical/Alphabetical)

Target Audience

This mode is designed for users with significant physical motor limitations and individuals with cognitive disabilities (e.g., autism) who benefit from high predictability and reduced search-and-selection time.

Mapping Logic (Alphabetical Directive)

Characters are mapped in clockwise alphabetical and numerical order. The Left Dome direction selects the character group, and the Right Dome selects the character within that group.| Left Dome Direction | Right Dome Zone (1-4) | Right Dome Zone (5-8) || ------ | ------ | ------ || **Up** | A, B, C, D | E, F, G, H || **Up-Right** | I, J, K, L | M, N, O, P || **Right** | Q, R, S, T | U, V, W, X || **Down-Right** | Y, Z, 0, 1 | 2, 3, 4, 5 || **Down** | 6, 7, 8, 9 | Reserved, Reserved |

Cognitive Rationale

By employing a strict logical progression, the system minimizes the "hunt and peck" complexity. This facilitates rapid kinesthetic skill acquisition, as the user can predict the location of a character based on its position in the alphabet, reducing the cognitive load on memory retrieval during the early stages of learning.

4. Layout Mode II: Legacy (QWERTY-Mapped)

Mental Model Transfer

Utilizing the "Construction of a Mental Model Using GOMS," this mode leverages the existing kinesthetic memory of expert typists. While the motor actions transition from vertical strikes to horizontal swipes, the spatial relationships between characters are preserved.

Mapping Directive (QWERTY Segments)

The Left Dome activates character groups that correspond to traditional QWERTY segments.

- **Left Dome (Up):** Q, W, E, R, T (Select via Right Dome 1-5)
- **Left Dome (Left):** A, S, D, F, G (Select via Right Dome 1-5)
- **Left Dome (Down-Left):** Z, X, C, V, B (Select via Right Dome 1-5)
- **Left Dome (Right):** Y, U, I, O, P (Select via Right Dome 1-5)

- **Left Dome (Down-Right):** H, J, K, L (Select via Right Dome 1-4)
- **Left Dome (Down):** N, M (Select via Right Dome 1-2)

Transition Analysis

Despite the lack of direct motor cue transfer, maintaining spatial congruence with the QWERTY layout allows expert typists to migrate to the chorded system with minimal interference. The mental retrieval of "left-hand home row" translates directly to a "Left Dome Left-Flick," significantly shortening the adaptation phase.

5. Layout Mode III: Pro/Efficiency (Biomechanical Optimization)

Design Principles

Mode III adheres to the principles of Spatial Separation, Hand Symmetry, and Spatial Congruence. High-frequency characters are mapped to the cardinal directions (Up, Down, Left, Right) to minimize decision time and leverage the most natural range of motion.

Frequency-Based Mapping Directive

Based on English letter frequency and "mean error as a function of letter" data, the mapping is optimized as follows:

- **'E' (Highest Frequency):** Left Dome: Right | Right Dome: Zone 1 (Primary natural extension)
- **'T':** Left Dome: Down | Right Dome: Zone 1
- **'A':** Left Dome: Up | Right Dome: Zone 1
- **'O':** Left Dome: Left | Right Dome: Zone 1
- **'I':** Left Dome: Up-Right | Right Dome: Zone 1
- **'N':** Left Dome: Down-Left | Right Dome: Zone 1

Optimized Chording

To maximize Gross Words Per Minute (GWPM), common digrams are mapped to allow for hand symmetry. This optimization reduces the biomechanical "decision time," prioritizing the most efficient directional combinations for 80% of the standard English lexicon.

6. Dedicated Symbol Layer (Black Selector Specification)

Reserved Selector Logic

The "Black" color zone on the Right Dome is hard-coded as the toggle for the Symbol Layer. Engaging the Black selector shifts the Left Dome into a dedicated functional state.

Left Dome Symbol Mapping Directive

Left Dome Direction,Symbol Output
Up,!
Up-Right,@
Right,#

Down-Right,$
Down,%
Down-Left,^
Left,&
Up-Left,*

7. Cognitive Load and Learning Proficiency

Performance Metrics

Predicted user performance based on the 1994 research results:

- **Learning Threshold:** Users typically reach the 5-hour adaptation threshold to stabilize motor control.
- **Expected Speed:** 60% of QWERTY speed achievable within the first 5 hours of practice.
- **Accuracy Rates:** A target rate of 98.3% accuracy is expected once the kinesthetic process becomes habitual.

Subjective Workload (NASA-TLX)

Initial NASA-TLX results indicate a higher subjective workload during the "adaptation" phase due to the novelty of the motor-perceptual code. However, workload measures drop significantly after the 5-hour mark as the task shifts from conscious retrieval to habitual kinesthetic response, ultimately resulting in lower physical fatigue than QWERTY.

8. Implementation Requirements for Android

Actuation and Dead Zones

The virtual joysticks must implement an "8-position star" logic with 45-degree sectors. A central "dead zone" must be calibrated to prevent accidental activation. Pressure sensitivity (where hardware permits) should be calibrated to 0.8 Newtons to facilitate "relaxed finger weight" resting without triggering input.

Visual Feed-Forward Mechanism

The UI must utilize "Character Identification Rings" that provide dynamic, real-time visual feedback.

- **Dynamic Update:** As the user initiates movement on the Left Dome, the Right Dome's Character Identification Ring must update *dynamically* to show only the available characters for that specific direction.
- **Purpose:** This serves as a "feed-forward" mechanism, aiding the "hunt-and-peck" method for beginners and reducing errors caused by visual deprivation during the learning phase.

Input Handling

The system must be capable of processing asynchronous joystick movements, but only committing the character chord upon both domes reaching the angular threshold. This mimics the mechanical "mounting shaft" feedback of the original Keybowl architecture within a touch-sensitive environment.