FP(KEY)A

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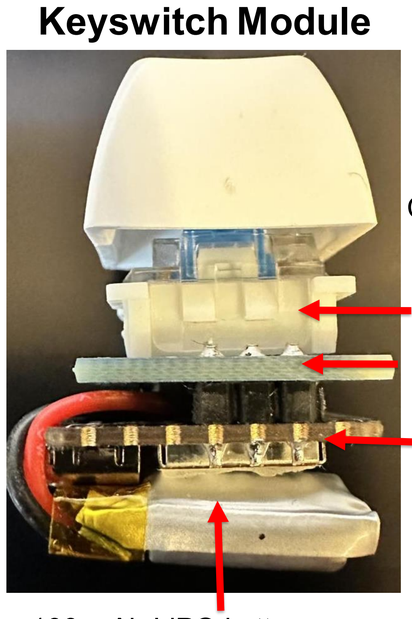
Product Pitch

With the FP(KEY)A, users can use their imagination to create any keyboard layout they want by moving the individual keys around. Perfect for streaming, gaming, or video editing, each key can be individually programmed to execute a variety of functions. Connecting wirelessly with quick response times of only 37.5ms, keys can be placed up to 15m from the receiver. If a key ever runs low on battery, it can be charged up wirelessly overnight, or plugged in to charge even faster over USB-C. Each key has enough battery life to last for 2 days of average use, or over 12 hours of continuous use.

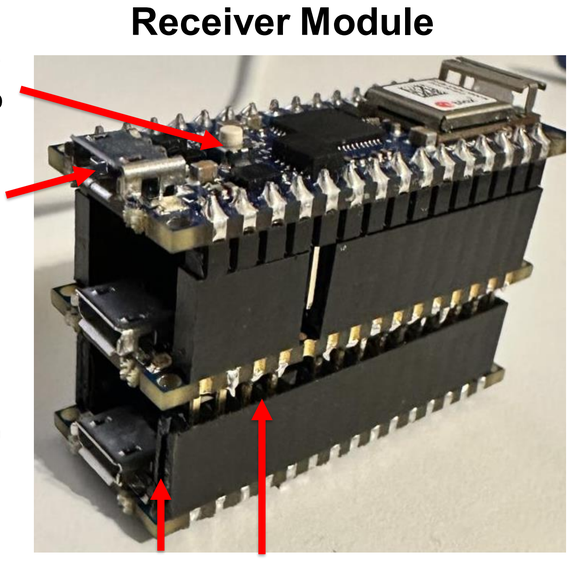
System Description

Each key is encased in a 22mm x 24mm x 20mm 3D printed housing and has a SEEED Studio XIAO nrf52840 microprocessor boards inside to handle the BLE connectivity and charging. A 100mAh battery powers each switch, which can be recharged wirelessly by the inductive coil. Each switch module has a single switch PCB to enable hot swap capabilities. The keys connect to a stack of 3 Arduino Nano 33's, each connecting to 5-6 keys. These receivers then forward the key press data to a central Arduino Nano 33 IoT, which then sends the data to the computer through USB-C. Additionally, each key can be programmed to be any combination of letters and modifiers with our software (like 'Ctrl+Z' or 'abcde'). Each key is then held down with 3M Dual Lock velcro and can easily be moved to be anywhere on the board or elsewhere.

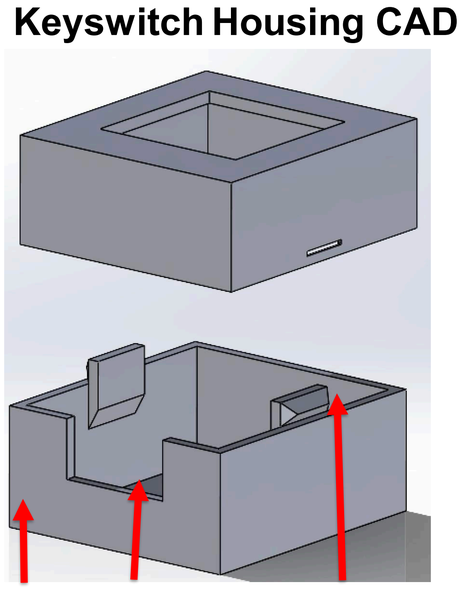
Keyswitch Module



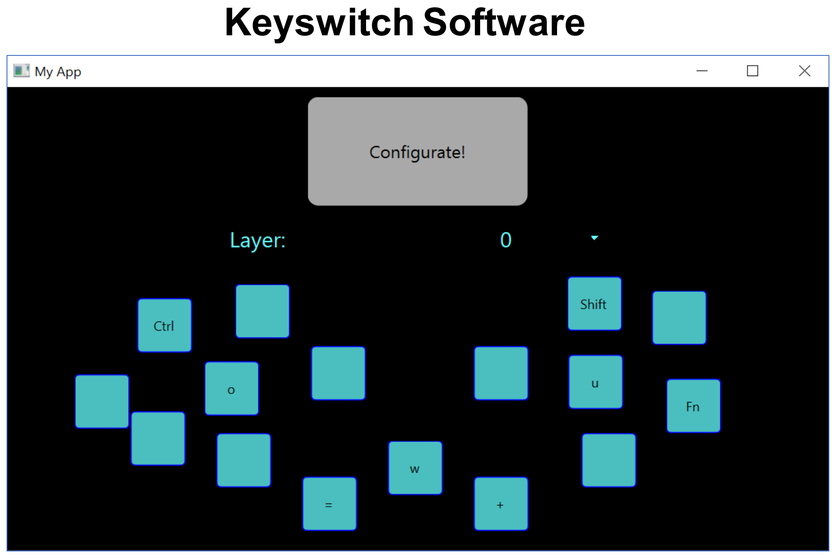
Receiver Module



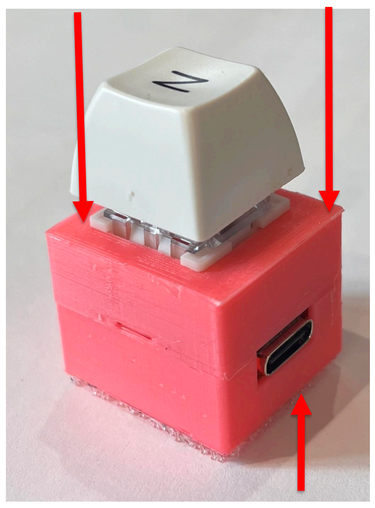
Keyswitch Housing CAD



Keyswitch Software



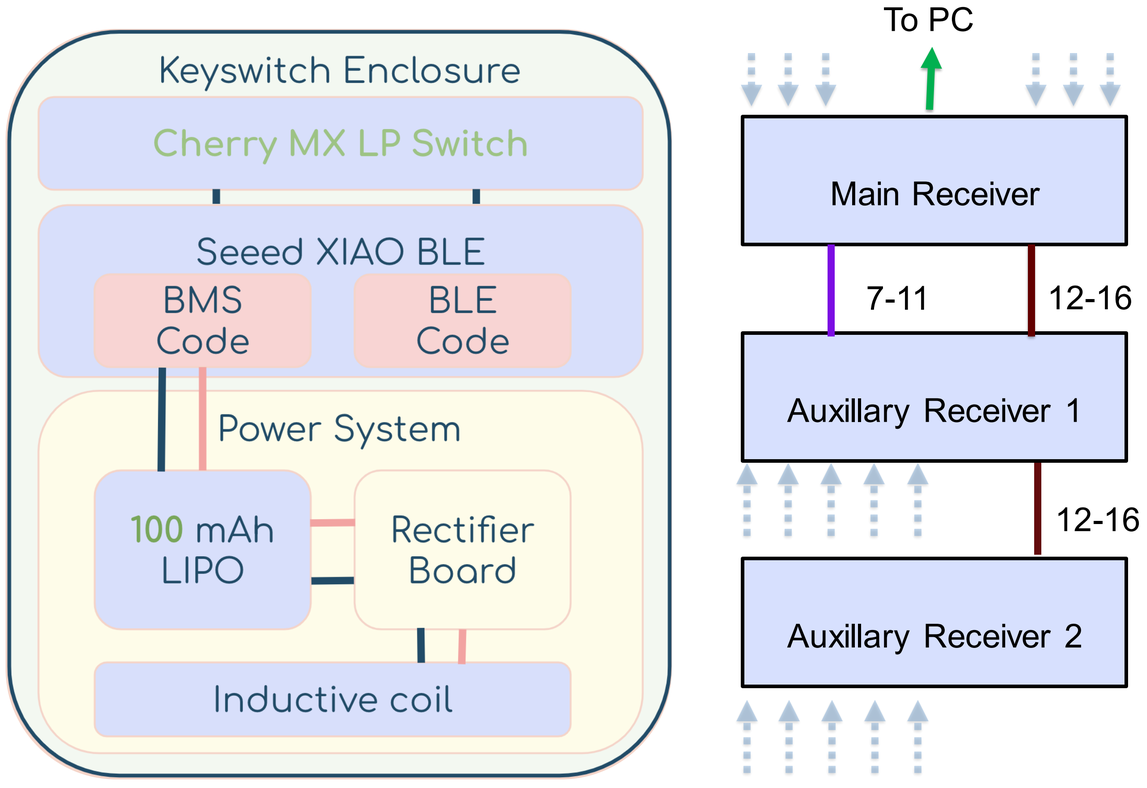
Keyswitch Housing



FP(KEY)A Final Board

System Architecture

The Keyswitch module consists of an enclosure surrounding a Seeed Xiao BLE board, receiving key press signals from a key switch on top. The module is powered by a 100mAh LiPO battery, which itself is charged by a rectifier board connected to an inductive coil. The receiver consists of a main receiver and 2 auxiliary receivers. The main receiver connects to keys 1-6 and forwards the signals received from the other receivers to the PC. Auxiliary receiver 1 connects to keys 7-11, and the last receiver connects to keys 12-16. Each auxiliary receiver has 5 pins allocated to it which forwards keypress data to the main receiver.



System Evaluation

Latency	1000ms/s*s/240 frames * 9 frames = 37.5 ms
Wireless Charging Speed	100mAh/17mA = 5.88 h < 8h
Battery Life	Current Draw Active = 6.5 mA Current Draw Sleep = 0.7 mA Continuous Usage = 100mAh/6.5mA = 15.4 h Sleep Usage = 100mAh/0.7mA = 143 h 7h/day, duty cycle 70% = 7h * 0.7 = 4.9h active / day 4.9h*6.5mA + 19.1h*0.7mA = 45.22mAh / day 100mAh/45.22mAh = 2.2 days
Cost for Mass Production	Total = (8.99 (Seeed board) + 1.00 (LIPO) + 3.58 (Wireless PCB) + 0.094 (Hotswap)) × 16 (keys) + 24.00 × 2 (Main microcontrollers) Bulk Order Items: •LIPO (3000+ pcs/batch) = $1.00 •Hot Swap PCB & sockets = 0.024 + 0.07 •Wireless PCB + inductor = $3.58
Stability	No perceptible wobble on camera
Portability	Total Weight = 323g + 3g*16 keys = 371g < 1kg
Wireless Typing	Yes
Layout Freedom	Yes

Conclusions & Additional Information

Overall, we believe that our system of 16 keys that can be moved anywhere shows the flexibility of keyboard layout that we wanted. We learned a lot about reading datasheets and the difficulties of synchronizing wireless communication. In the future, it would be possible to expand the system by adding more keys, and possibly add lighting effects to each individual key.