

Motivation

User Identification and Authentication: Today's mechanisms are cumbersome, unsecured and doesn't support brief usage and device sharing

- Manually entering PIN codes, passwords, and swiping patterns is cumbersome and unsecured
- Biometric-based approaches, e.g. iris, finger print, vein, voice, face recognition, require specialized hardware and manufacturer support
- Mobile (e.g. phones, tablets) and non-mobile (e.g. ATM machines) devices are pervasively equipped with capacitive touchscreen
- Need an unobtrusive, easy-to-use and low-cost mechanism that works with off-the-shelf touchscreen-enabled devices

Capacitive Touch Screen

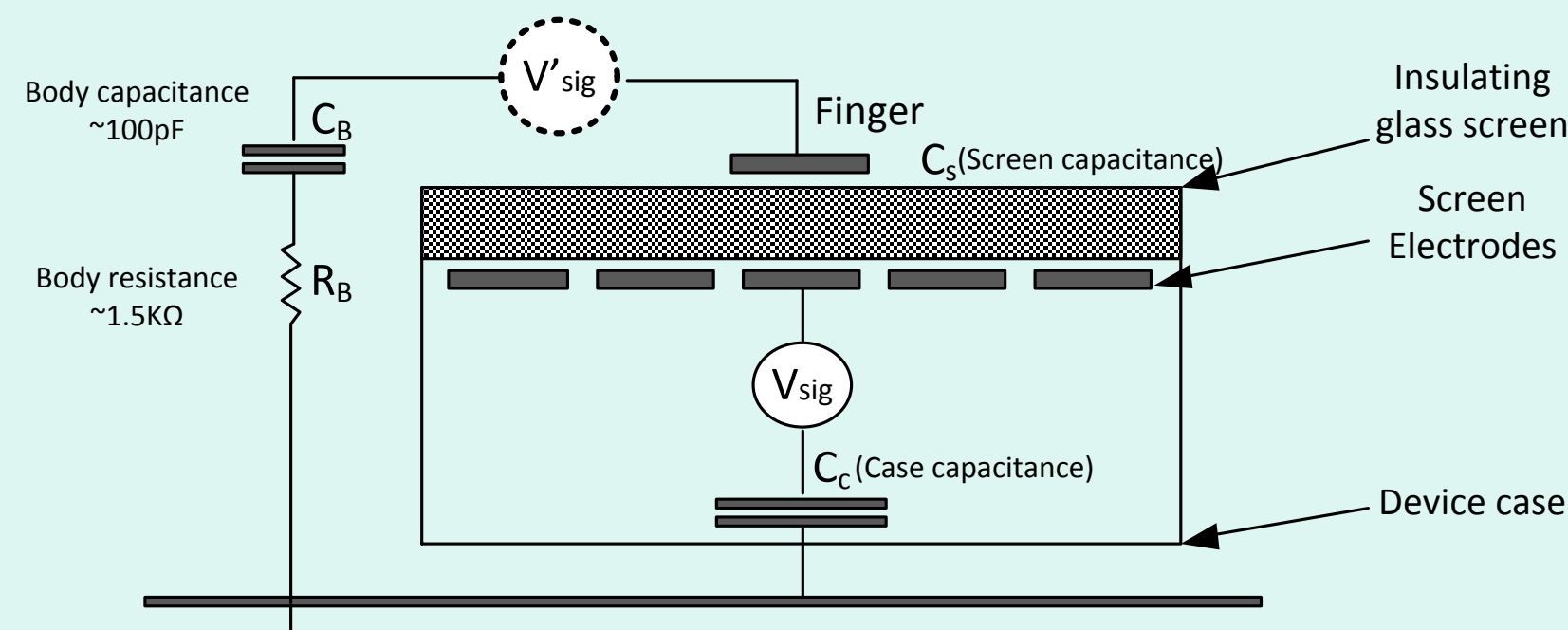


Fig 1: Schematic of a basic capacitive touchscreen

- **Background:** A capacitive touch screen consists of an array of conducting electrodes behind a transparent, insulating glass layer which detects a touch by measuring the additional capacitance of a human body in the circuit.

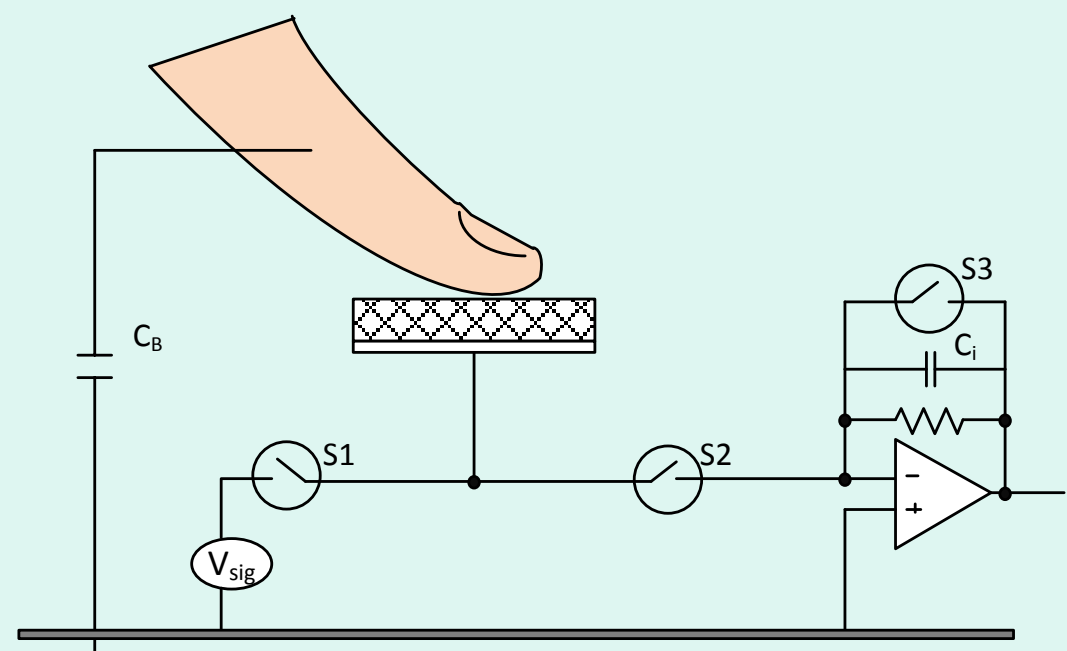


Fig 2: Internal touch detection circuit

- **Creating artificial touch events:** We discovered a technique for "spoofing" the screen detection algorithm by causing the system to alternately register touch/no touch conditions even when the finger is not moving. This allows us to send a digital signal into the touchscreen.

Capacitive Touch Communication

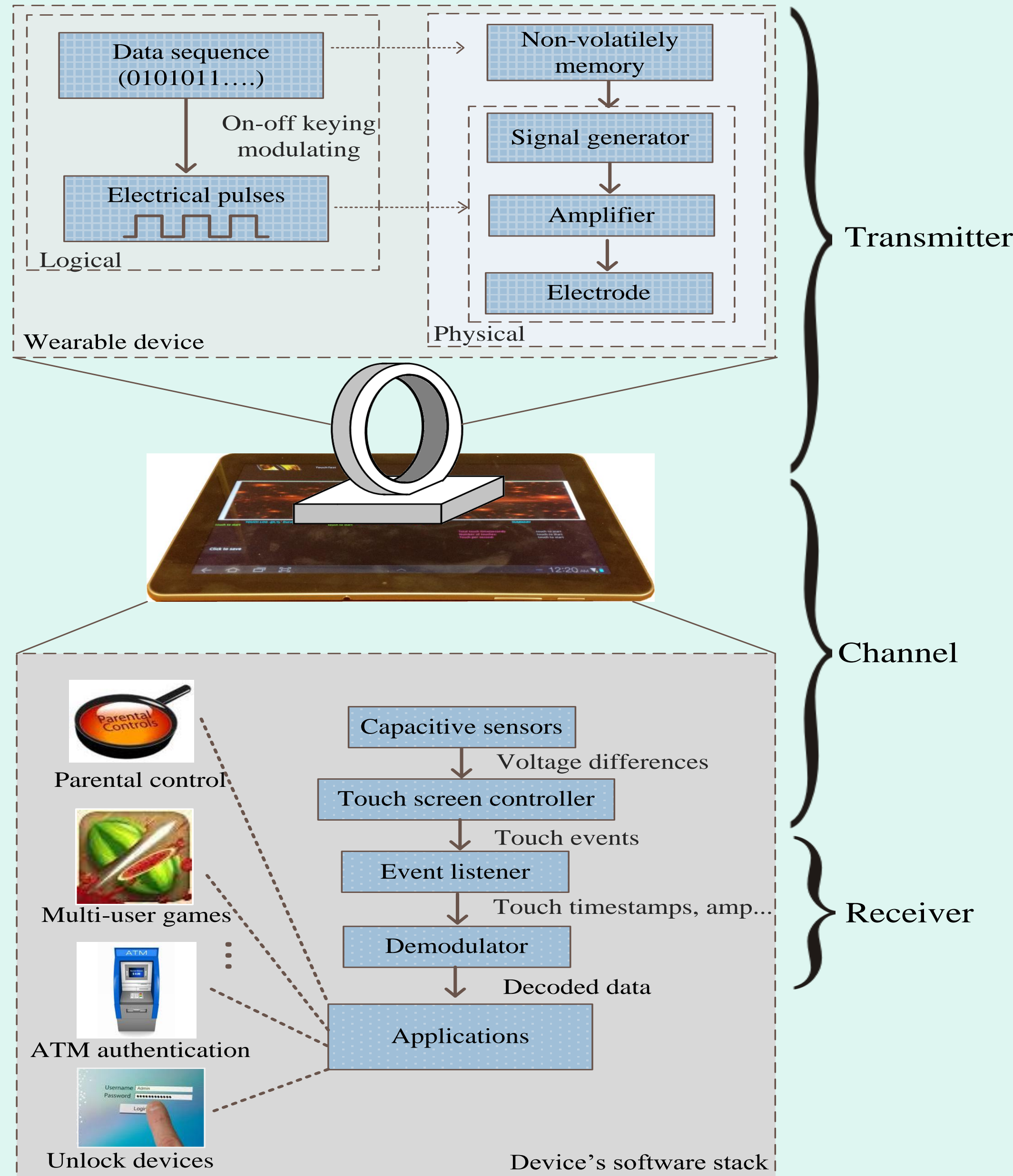


Fig 3: Overall architecture of the capacitive touch communication system

- **Transmitter:** A wearable battery-powered hardware token generates electrical pulses demodulated to represent a bit sequence that is stored in a small flash memory
- **Receiver:** A software component residing on the tablet demodulates the transmitted bit sequence based on **number of registered touch events**
- **Channels:** All hardware and software components that affect the relationship between the transmitted bit sequence and the events registered, i.e. Series of capacitance, firmware, drivers

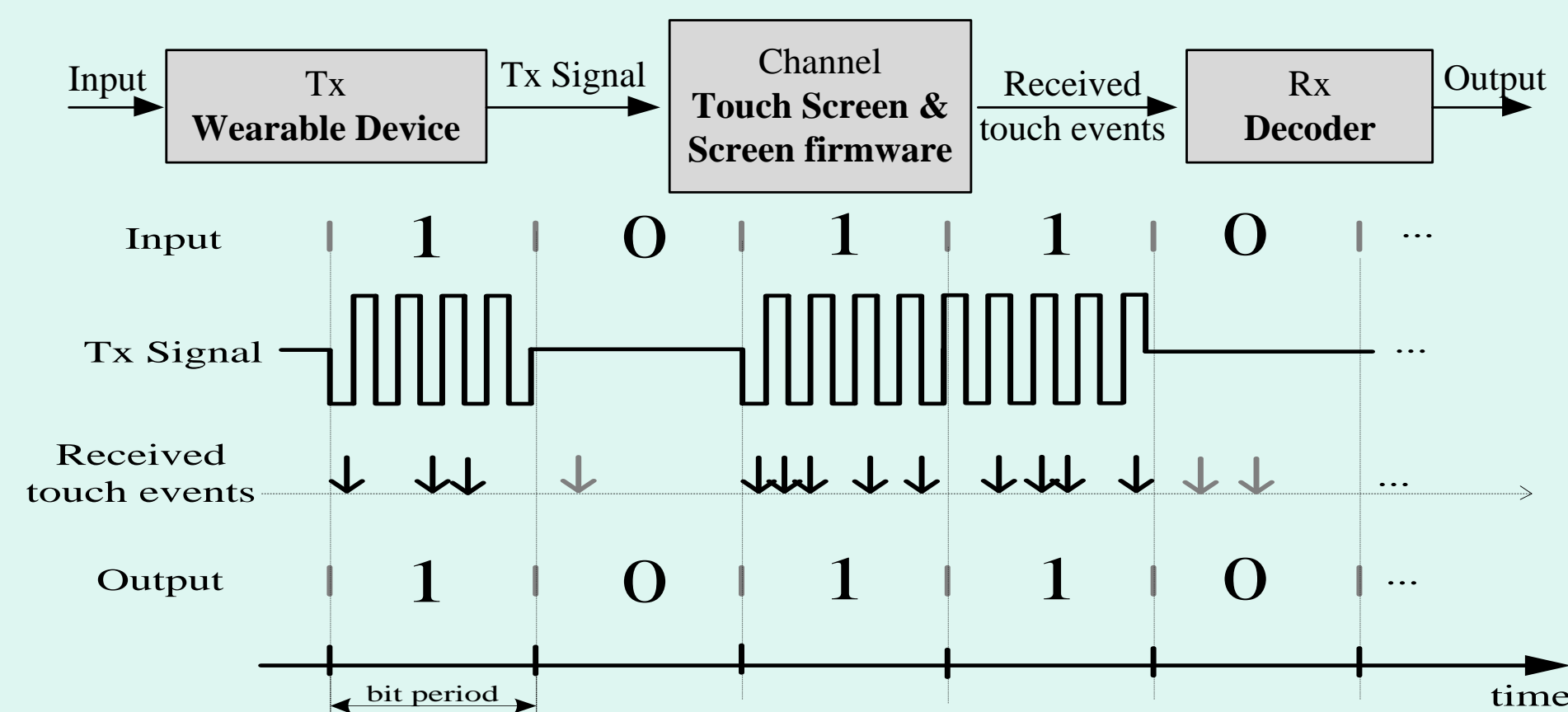


Fig 4: Capacitive touch screen communication showing OOK modulation and variations in number and timing of generated events

Challenges

This unconventional use of the touchscreen under the constraint of using commercial off-the-shelf poses a number of challenges:

- The receiver responds differently to the same input following a different bit pattern
- Delay between the transmission of a symbol and its reception at the receiver after processing through all layers of firmware and software varies
- The channel adds an unknown delay between receiver and transmitter

Hardware Token Prototype

- A custom-built battery-powered hardware token controlled by a battery-powered microcontroller TI-MSP430F2722 that is programmed to carry a user's identification in the form of a bit sequence.

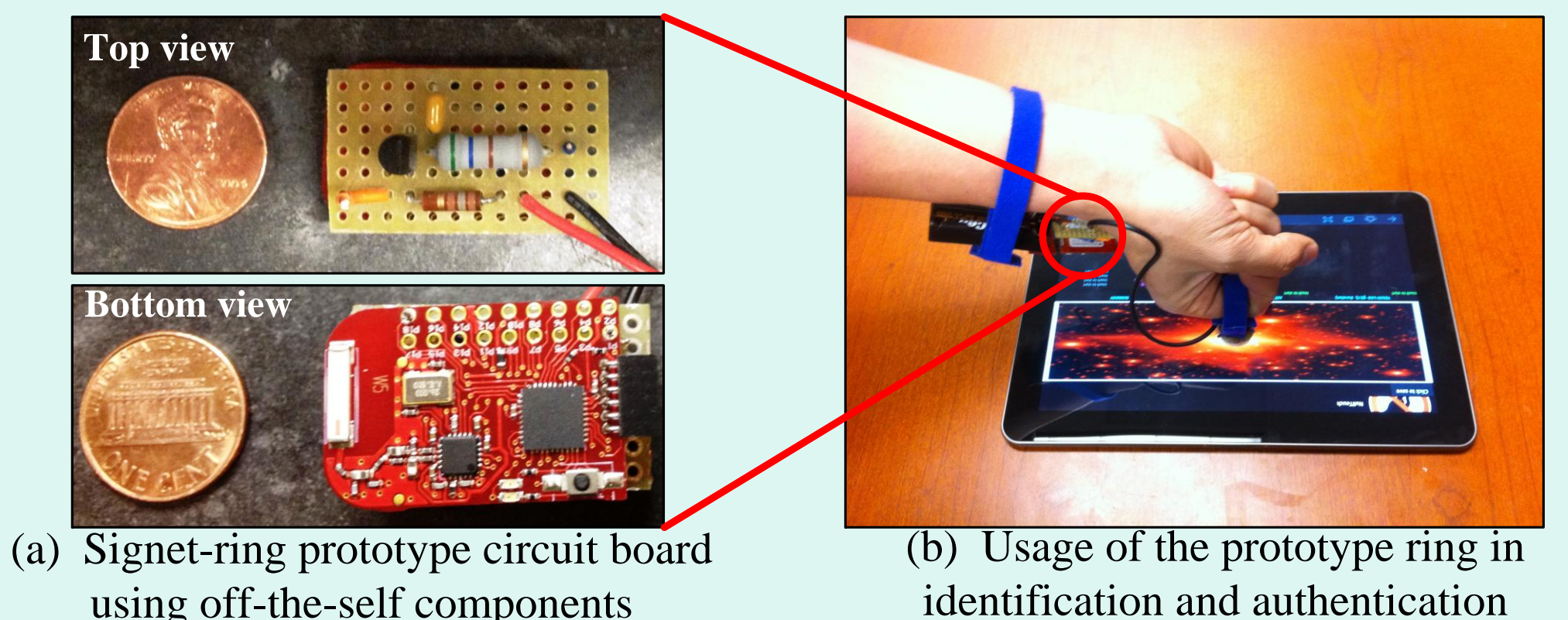


Fig 5: The prototype ring and its usage for transmitting short messages from the ring to a touchpad

Evaluation Results

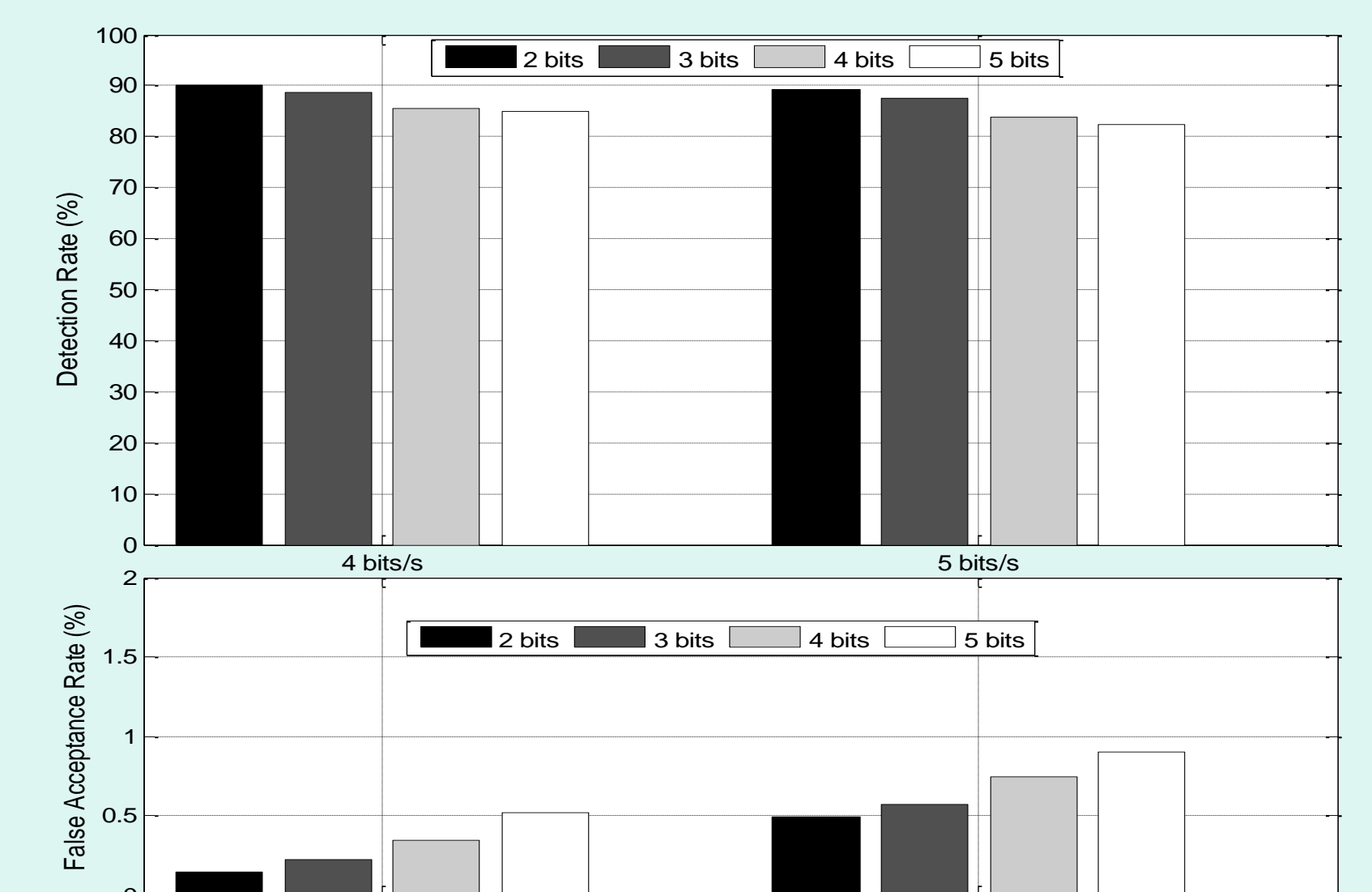


Fig 6: Detection rate and False acceptance rate using ring prototype for different message lengths and bit rates

Reference

*Tam Vu et al., *Distinguishing Users with Capacitive Touch Communication*, *MobiCom 2012* - to appear