HyPR Device: Mobile Support for Hybrid Patient Records. Houben, et al. ITS. 2014.

What are the core research questions addressed by the work?

- Addressing the complications of maintaining a double record (one electronic, one physical) system in hospitals

What motivates the work?

- A typical setup in many hospitals is that the EHR system does not replace the paper-based system, but instead a double record consisting of both an electronic and paper part is maintained
    - Results in configuration problems related to finding, using, managing both the paper and electronic representation of the patient record
        - Synchronization problems
        - Mobility
        - Physical replacement and loss

How does the work understand the usage, capabilities, and limitations of paper?

- Capabilities of paper: handleable, manipulatable, portable, easier to use for fast, informal note taking, better suited to “nomadic” work environments
- In the context of medical record keeping:
    - Physical patient records are not as secure, more complex, less standardized, and more difficult to access than electronic health records
    - Physical paper records are still actively used as a central artifact
    - Physical paper is used frequently for storage of more informal records
    - A unique paper-based medical record is kept as a legal requirement for each patient
    - Parallel to the paper record, the hospital uses a number of specialized health information systems

What is the target application domain of the work?

- Medical record keeping

What are some proposed extensions to paper proposed by the work?

- Formulation as a two part system connected with an intermediary device (the HyPR device): traditional paper patient record, electronic record accessed from table or phone
- The HyPR device: A rectangular plastic plate with the same width and height as the paper record attached to the plastic plate using metal clips to create a permanent connection to the device
- Provide three features:
    - Pairing of tablet and paper record using proximity system
        - Allows changes made to the electronic record is immediately propagated through the infrastructure
        - Supports blending paper-based and digital information in both directions
    - Light and sound system that can be used to augment the record or notify other clinicians
        - Once the device is paired, clinicians can change the physical properties of the HyPR record by changing its color scheme or identification sound

    - An integrated location tracking unit that allows clinicians to locate the record

What design constraints or objectives guided the work's implementation of the proposed extensions?

- Dual use: Setting up and removing the connection between the paper record and a device representing the electronic record should be instant and easy. Both representations should be usable separately, without any changes to their original purpose or use. Paper as the identifying document. Hybrid record to load and visualize the correct data.
- Recognizability: To support easy identification and recognition of a patient record, the patient record should relay and display various kinds of status and awareness information
    - Visual and auditory clues for self-reflection or coordination with other clinicians
- Mobility: Patient records should support the nomadic workflow in hospitals
    - Electronic and paper representation of patient data should be available in a portable and traceable form factor

How are the proposed extensions implemented?

- (1) an rectangular plate of 2.5 mm food-safe transparent plastic, (2) an enclosure holding the electronics embedded into the side of the plate
    - Electronic architecture: Arduino ATmega168, RFID module with antenna, RGB LEDs, range buzzer, rechargeable Volt battery, power switch, ultrasound tag
- To support communication between tablet and HyPR device, firmware provides support for custom protocol with a set of command messages

What findings have been obtained from either the implementation process or an evaluation of the proposed system?

- The HyPR device provided clinicians with a tool to synchronize and merge the paper and contextual digital representation of patient data, which significantly reduces configuration work
- The location tracking feature of the HyPR device provides clinicians with a spatial coordination tool designed to reduce search times
- HyPR found to increase awareness of patient data
- HyPR device designed to support user multiplicity: Enable multiple tablets connected to the same HyPR device
- Current limitations: Does not actually fully integrate the digital and physical workflows, rather supports alignment
    - Deliberate absence of digital support for separate paper documents and forms
    - Paper forms and electronic records simply do not align one to one, thus providing fundamental questions on how these tools can be integrated and how they would effect work practices
    - Device is too cumbersome