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Effectiveness of a Biometric Patient Identification System

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Scientific Areas of Interest:

e-Health

Internet of Things

Knowledge management for people with disabilities

Web and Mobile Development

Structure

1. Introduction
2. Research
3. Methodology
4. Design
5. Evaluation
6. Results
7. Conclusion & Future Works

1. Introduction

Around 2.6 million deaths[1] per year, due to medical errors

684 patient misidentification events in the US led to patient harm, and in some cases, death (32 months span)

Missing patient wristbands or incorrect information on them

$42 billion[1]

&

$1.2 million[2]

in costs each year

[1] In low to middle-income countries (WHO)
[2] for the average healthcare organization in the US ("2016 National Patient Misidentification Report" independently conducted by Ponemon Institute LLC Sponsored by Imprivata)

Objective - Effectiveness of using biometric technology for identifying patients

Research

- Patient Identification Process
- Existing problems
- Identification methods and solutions
- Security and privacy issues

System Requirements

- Developing a list of system requirements
- By means of a questionnaire to healthcare professionals

System Proposal

- Propose a system based on biometric technology

Objective - Effectiveness of using biometric technology for identifying patients

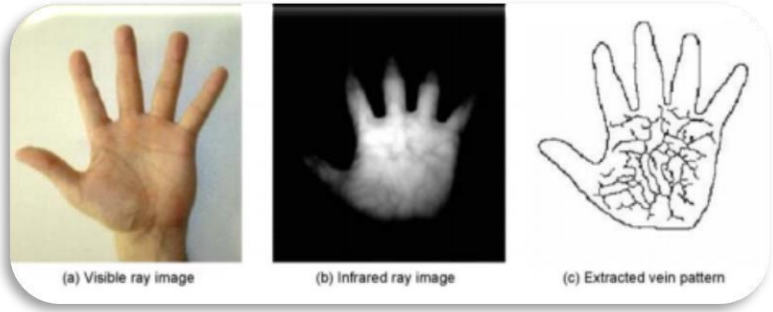
Evaluation	System versus a dataset
Analysis	The results
Recommendations	How to improve the system

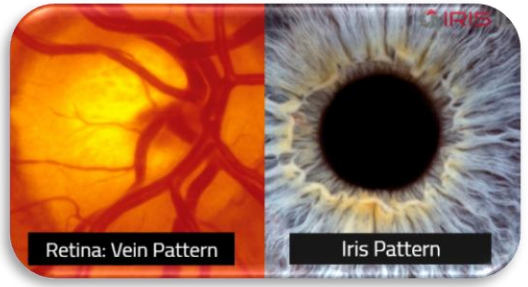
2. Research

Identification methods

ii. Palm Vein Pattern Recognition

iv. Face Recognition





i. Wristbands

iii. Ocular Based Identification

i. Wristbands

- Written wristbands
  - Leading cause for misidentification
  - Missing and wrong information
  - Damages and Tort cases
- Barcoded Wristbands
  - Reduce medical errors by 57%
  - Damage control and money saver
  - Cheap, portable and easy to use and maintain

Image source: https://www.statnews.com/2016/01/28/experts-argue-unique-patient-identifier/

ii. Palm Vein Pattern Recognition

Uniqueness of palm vein pattern

Impossible to reproduce with fake palms

More accurate – More costly and Intrusive

Less Hygienic

Image source: https://www.statnews.com/2016/01/28/experts-argue-unique-patient-identifier/

iii. Ocular Based Identification

Iris

- Does not require proximity to camera
- Iris recognition – UCSD`s Moore Cancer Center[1]

Retina

- Requires proximity to camera
- Unique for each person due to complex structure of capillaries
- Diseases may affect scan accuracy

[1]B. N. HAILE, "THE EYES HAVE IT : IRIS BIOMETRICS SAFELY IDENTIFY UCSD PATIENTS FOR RADIATION ONCOLOGY TREATMENT," 2010.

Image source: https://www.irisid.com/iris-recognition-and-retinal-scans-are-not-the-same/

iv. Face Recognition

Identification of person by facial features	Challenges for faces with occlusions	Cheap to use	Hygienic	May be Intrusive	Less accurate than palm vein and ocular based scanning

3. Methodology

Questionnaire

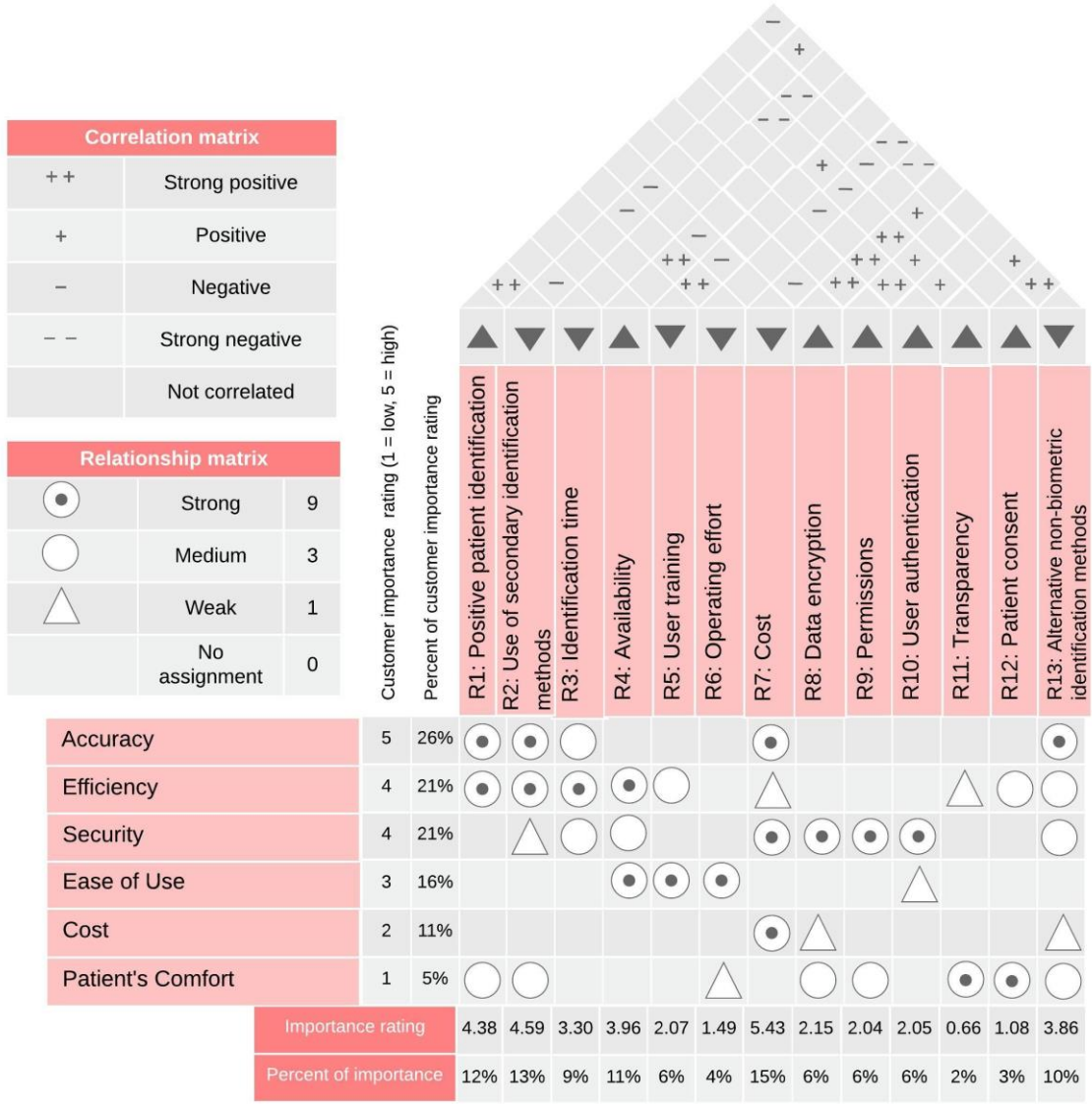
- **Stakeholder** information
- Their **awareness** of the problem, if any
- Their **process** of patient identification
- Their **preferences** of **solutions**

Participants

- Nurses
- Doctors
- Physiotherapists
- Surgeon
- Speech language pathologist

Results

- **67%** think that their current system works moderately well, with **low-cost** being the main reason behind this
- **Security** was the biggest concern



House of Quality (HoQ) Matrix for System Requirements

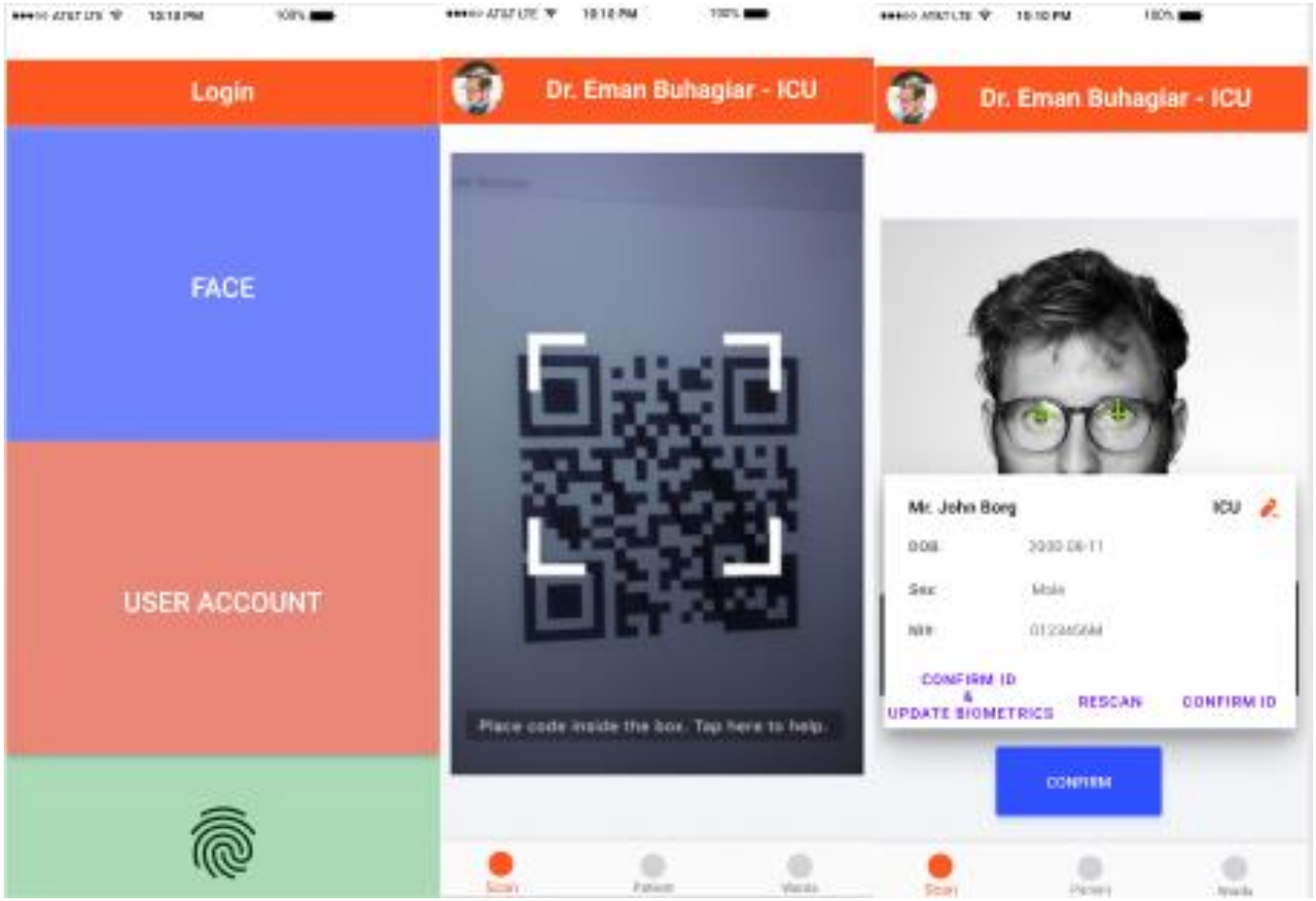
4. Design

- **Mobile app** with user authentication and authorisation.

- User can identify an already registered patient by:
  - **Scanning** the patient’s barcode
  - Taking a **photo** of the patient’s face
  - **Confirming** the patient details

- Patient crucial information is then displayed on the phone, which can be adjusted to the organization’s needs.

4. Design



Proposed app system designs. Authentication, Barcode/QR code scanning, Identification confirmation

5. Evaluation

Implementation using Microsoft Cognitive Services and their Face API

- **Seamless**, **secure** and **easy** to integrate and operate
- Face images are **not stored** on their servers
- Configurable confidence **thresholds**
- Relatively **cheap**

Accuracy Evaluation

- **Dataset** of faces[1] to be evaluate against
- All faces were registered with the API
- Identification was **tested**

Performance Evaluation

- A **proof-of-concept mobile application** was developed
- Scanning of a barcode and a person's face
- Biometric information sent to Microsoft Face API for identification.
- Database call to fetch patient's fake records.

[1]S. Milborrow, J. Morkel, and F. Nicolls, "The MUCT Landmarked Face Database," Proc. Pattern Recognit. Assoc. South Africa, pp. 32–34, 2010..

6. Results

- Accuracy
  1. Different **angles**:
     - **88%-93%** with 0.97 confidence
     - **100%** with 0.94 confidence
  2. Different **lighting**:
     - **40%-44%** with 0.97 confidence
     - **93%-97%** with 0.94 confidence
  3. After **training** the dataset:
     - **65%** with 0.97 confidence
     - **97%** with 0.94 confidence
- Performance
  - **5 to 7 seconds** with full-bar Wi-Fi connection to detect and identify the patient and get their records from a database.

TABLE I. CASE 1 RESULTS

Thr. / Sc.	0.97	0.96	0.95	0.94
b	88.04	98.55	99.28	100.00
c	88.04	98.55	99.28	100.00
d	99.28	100.00	100.00	100.00
e	93.48	97.83	98.91	100.00

n = 276

TABLE II. CASE 2 RESULTS

Thr. / Sc.	0.97	0.96	0.95	0.94	0.93	0.92
rb	43.96	73.63	90.11	96.70	100.00	100.00
sb	39.56	64.84	82.42	93.41	98.54	100.00

n = 91 (photos 000 - 090)

TABLE III. CASE 3 RESULTS'

Thr. / Sc	0.97	0.96	0.95	0.94	0.93
sb	64.84	82.42	92.31	96.70	100.00

n = 91 (photos 000 - 090)

Conclusion and Future Works

Patient Misidentification

- Known global problem in the Health Sector
- Complications - Patient and Organisation

Face Recognition

- This was the main focal point of study for identification of patients
- Most biometric preferred method chosen by questionnaire participants
- Over 80% accuracy

Conclusion and Future Works

Future Works

- System needs to be evaluated against a larger dataset
- More face occlusions and real-case scenarios

Security Aspects

- Minimise risks of malicious attacks
- Gain more confidence from end users.

Thank you for your attention!

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