AirSupport

Vital Monitor and ID Detection through Machine Vision for Improving EMS Communication Efficiency

Group 11:
Robert Huang

Clinical Mentors:
Dr. Nick Dalesio
Dr. Laeben Lester

Computer Vision Mentor:
Dr. Mathias Unberath

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Brief Goals

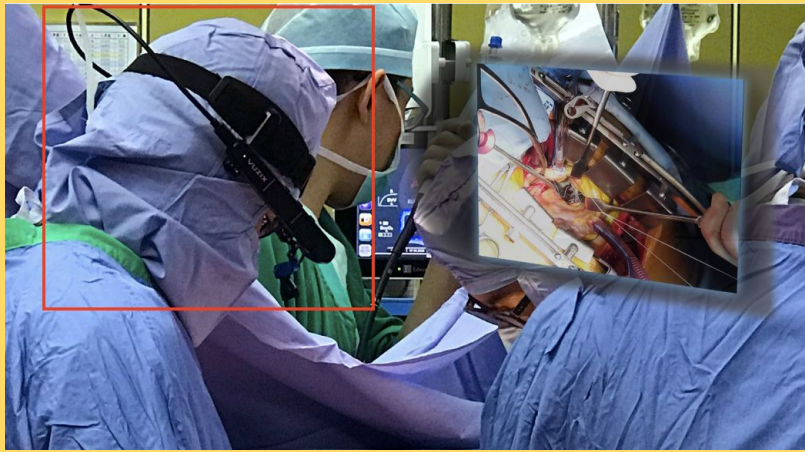
Two Objectives:

- **Objective 1:** Provide View of Data Monitors Remotely with AI and Computer Vision from Smart Glasses Feed

- **Objective 2:** Automatically record and insert information into a digital medical note from Smart Glasses Feed

Background

- Smart Glasses in healthcare to **record and stream** live feed [1].
  - Camera connects to Smartphone.
  - Environments: Surgical Rooms, On the field
- Uses in healthcare [1]:
  - Obtaining remote professional advice.
  - Training healthcare workers.
  - Observe the patient remotely.
- Room for AI

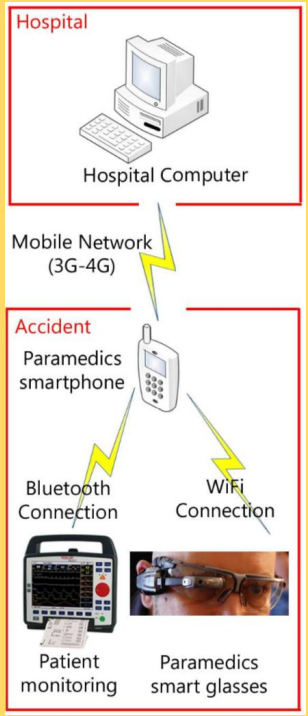


[1]

[1] Vuzix Corporation, 2020

Motivation

- Objective 1: Provide View of Data Monitors Remotely with AI and Computer Vision
  - **With Visual Confirmation of Vitals:**
    - Physicians are **2-3x more confident** and give treatments **2-3x faster** [2]
    - Receiving hospitals get prepared earlier. [2]
  - **Current State:**
    - Some ‘packages’ have monitors that provide vitals directly to bluetooth. [2] However, **standardization of devices is poor** [3], and devices not within the ‘package’ do not.
    - Without recording vitals, 43.4% of information **can be lost**.



[2]

[5]

[2] Schaer, et al., 2016
[3] GreenLight Medical, 2020
[4] “LIFEPAK 15”, 2021

Motivation

- Objective 2: Automatically record and insert information into a digital medical note from IDs.

25-65%

of a patient's EMS care is spent documenting [5]

1-10min

Can be spent obtaining simple information (name, birth date, address, ID#) [6].

[5] Crawford, 2016
[6] Lester, 2021

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Goals and Significance

Two Objectives:

- **Objective 1:** Provide View of Data Monitors Remotely with AI and Computer Vision
  - Improves on-the-field outcomes by **increasing confidence and treatment speed**.

- **Objective 2:** Automatically record and insert information into a digital medical note.
  - Improves on-the-field outcomes by **moving time spent on documentation to patient care.**

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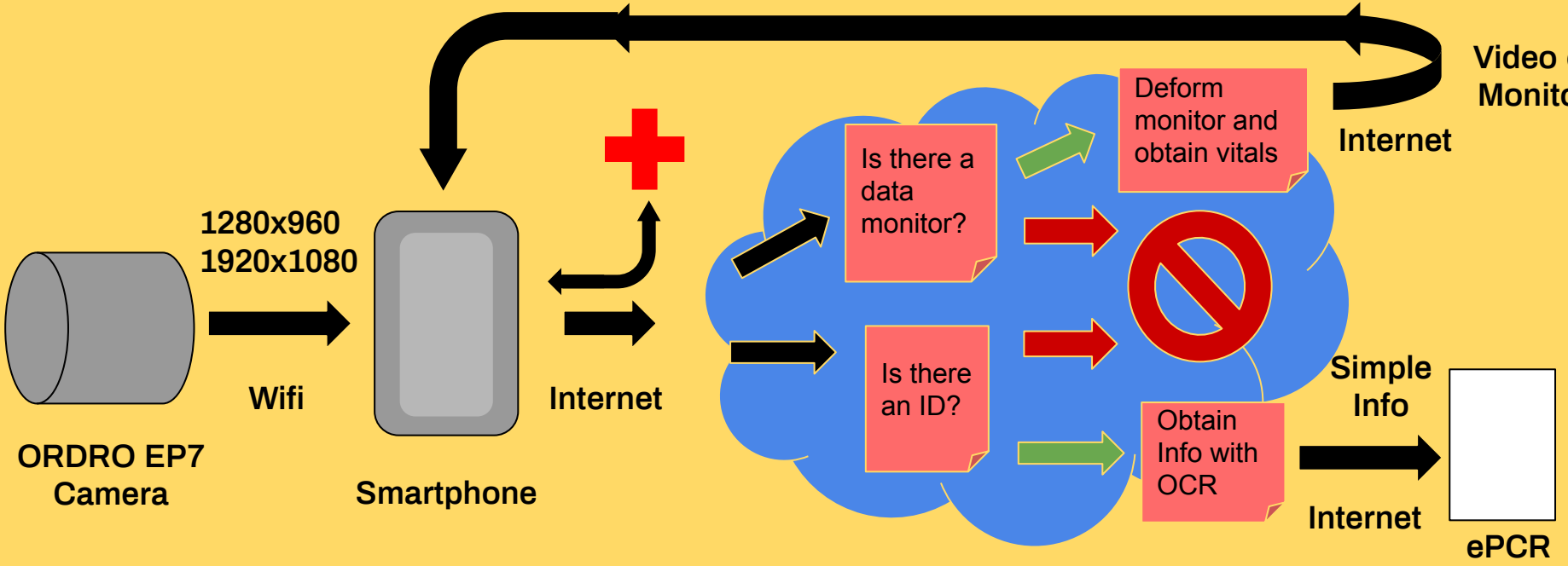
Technical Approach - Overall Workflow



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Technical Approach - Objective 1: Detection and Deformation of Data Monitors

- Steps:
  1. **Detect the display** of a vital signs monitor or ultrasound image.
     - YOLO Deep Learning Framework for Detection
       - Good for processing large and many frames per second.
       - Only need to detect whether **one** object (which monitor?) is present.
     - Dataset: Images of the device/monitor from multiple angles.

  2. Capture video when a display monitor is on camera and **preprocess and deform video** such that the monitor appears head-on.
     - Blob Feature registration and deformation.

  3. **Read vitals signs data.**
     - Optical Character Recognition (OCR) using deep learning technique by Wojna, Zbigniew, et al, 2017.

Technical Approach - Objective 2: Detection and Information Extraction of IDs

- Steps:
  1. **Detect the presence of an ID**
     - YOLO Deep Learning Framework
     - Dataset: Images of many state's Driver's' License, Medical Bands, School IDs, and Hospital IDs.

  2. **Read and categorize information on the ID.**
     - OCR using deep learning technique by Wojna, Zbigniew, et al, 2017. Combine with **Generic Text Parsing** to sort information.

Deliverables

	Activity	Deliverable	Expected Completion
Min	Obtain datasets of IDs and Medical Device with Monitors, and characters.	Dataset of IDs, Medical Devices, and characters	2/19
	Code the YOLO framework for detection of IDs. Train on ID dataset. Code the OCR framework. Train with character dataset. Code Generic Text Parsing Code and assess its performance with a constructed ground truth dataset. Combine code to read IDs.	Documentation of overall code and performances of each section.	3/15
Expected	Duplicate and Train YOLO on Medical Device dataset.	Documentation of code and performance of YOLO on Devices.	3/20
	Code Blob Feature Detection and deformation algorithm. Qualitatively assess how many deformations are acceptable.	Documentation of Blob Feature Algorithm and its performance.	3/30
Max	Incorporate the algorithms into the current overall workflow. Assess their performance in the workflow using a written test.	Documentation of incorporation. Testing procedures for performance assessment. Results of the tests.	5/1

Dependencies

Dependency	Need	Contingency	Status	Planned Deadline	Hard Deadline
ID/Medical Device/ Characters Datasets	For training and assessing algorithms	Begin coding without training.	Almost complete	2/19	3/20
Computer/Internet	For coding and communication	Use public computers. Use mobile data.	Currently met	Continuous	Continuous
MDAirSupport Sample Product	For testing for incorporation into overall workflow	Write procedures for other MDAirSupport to test.	Am being promised one	4/1	5/1
Deep Learning Mentor	For Optimizing Algorithm to reduce computation	Spend time researching optimization	Currently met	Continuous	Continuous
Microsoft Azure or other Cloud Computing	For incorporation into overall workflow. May also require for training.	For training: use public JHU computer.	Under consideration: If needed, will email.	4/1	5/1

Timeline/Milestones

Milestone	Deadline
Obtain datasets.	2/19
Code YOLO	2/22
Train YOLO on IDs and record results	2/25
Code OCR	2/29
Train OCR on characters and record results	3/1
Create Ground Truth Set for Generic Text Parsing	3/5
Paper Presentation	3/11
Code and Assess Generic Text Parsing and record results.	3/15
Combine all individual codes to read IDs	3/15

Timeline/Milestones

Milestone	Deadline
Duplicate YOLO and train on Devices Dataset and record results	3/20
Generate Test Set for Blob Feature Deform Algorithm Testing	3/22
Code Blob Feature Deform Algorithm	3/28
Assess Blob Feature Deform Algorithm and record results.	3/30
Investigate what components how to write to ePCR.	4/5
Feed video back into smartphone.	4/10
Incorporate all algorithms into workflow.	4/15
Generate tests to assess the functionality of the application.	4/20
Assess overall application functionality.	5/1

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Roles and Responsibilities

Team:
Robert Huang: Sole responsibility for all tasks

Clinical Mentors:
Dr. Nick Dalesio (Anesthesiologist, MD Airsupport Co-Founder):
Main Company Contact/Request, Dataset Generation, Network Architecture
Dr. Laeben Lester, (Anesthesiologist, Emergency Physician, and MD Airsupport Co-Founder): Headset Sample, EMS Experience

Computer Vision Mentor:
Dr. Mathias Unberath (Professor in the Department of Computer Science):
Advice for Algorithm Optimization

Management Plan

- Meetings:
  - Weekly Meetings with MD AirSupport on Friday 10AM
  - Imaging Meeting with Dr. Mathias Unberath on Friday 2PM
- Programs Used:
  - Communication through Email
  - Code on GitHub
  - Writing Reports and Documentation using OneLeaf and Upload onto CIIS Wiki

Reading List

- Redmon, Joseph, et al. “You Only Look Once: Unified, Real-Time Object Detection.” 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016, doi:10.1109/cvpr.2016.91.
- Shaifee, Mohammad Javad, et al. “Fast YOLO: A Fast You Only Look Once System for Real-Time Embedded Object Detection in Video.” Journal of Computational Vision and Imaging Systems, vol. 3, no. 1, 2017, doi:10.15353/vsnl.v3i1.171.
- Wojna, Zbigniew, et al. “Attention-Based Extraction of Structured Information from Street View Imagery.” 2017 14th IAPR International Conference on Document Analysis and Recognition (ICDAR), 2017, doi:10.1109/icdar.2017.143.
- Llados, J., et al. “ICAR: Identity Card Automatic Reader.” *Proceedings of Sixth International Conference on Document Analysis and Recognition*, doi:10.1109/icdar.2001.953834.

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References

[1] Vuzix Corporation. Vuzix Corporation, 2020, *VUZIX SMART GLASSES AT THE CHI MEI MEDICAL CENTER, TAIWAN*, ss-usa.s3.amazonaws.com/c/308483104/media/21105f5a523ce21ce43889049199725/Vuzix-Chi-Mei-Medical-Case-Study-2020.pdf.

[2] Schaer, et al. "Using Smart Glasses in Medical Emergency Situations, a Qualitative Pilot Study." *2016 IEEE Wireless Health (WH)*, 2016, doi:10.1109/wh.2016.7764556.

[3] GreenLight Medical. "Standardizing Medical Devices: Value Analysis." *GreenLight Medical*, 17 Mar. 2020, www.greenlightmedical.com/standardizing-medical-devices-in-hospitals/.

[4] "LIFEPAK 15." *Stryker*, www.stryker.com/us/en/emergency-care/products/lifepak-15.html.

[5] Crawford S, Kushner I, Wells R, Monks S. "Electronic health record documentation times among emergency medicine trainees." *Perspect Health Inf Manag*, 2019;16:1f.

[6] Lester, Laeben. "Inquiry into EMS Documentation Times." 14 Feb. 2021.

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Thank You!
Questions?