Vision Opportunities in Healthcare

Vini Jolly
September 2020
Introduction to WCP

Digital Health
M&A, strategic partnerships, and corporate finance advisory

Artificial Intelligence
Focused on emerging growth technology companies

AutoTech Report
Founded in 2001: over $8 billion in transaction value

Collaborative Robots
Offices in Silicon Valley, London, Shanghai

Dedicated Digital Health and Computer Vision corporate finance practice
Key Thoughts


2. Digital Health Is Hot! (Despite The Pandemic)

3. Computer Vision + Healthcare = A Natural Fit

4. CV Startup Ecosystem Is Thriving (Investments, Policy, Strategics)
# Embedded Vision / Visual AI Market Map

## Systems & Solutions
- **Consumer**
- **Agriculture**
- **Industrial**
- **Security & Surveillance**
- **Defense & Aerospace**

## Enabling Technologoes
- **Subsystems**
- **Components**
- **Enabling Services & Tools**

## Enabling Technologies by Sector
- **Camera Modules**
- **Cameras**
- **Automotive Tier 1 Suppliers**
- **Processors Boards and Modules**
- **Sensors**
- **Illumination**
- **Lenses**
- **Processors and SoCs**
- **Design & Manufacturing Services**
- **Development Tools**
- **Image & Video Data**
- **Silicon IP**
- **Standards**
- **Open Source**

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Market Size – US Health Spending
Healthcare spending is expected to increase significantly from $3.5 tn in 2017 to $5.9 tn in 2027

United States, 1967 to 2017, Selected Years, and 10-year Projection

<table>
<thead>
<tr>
<th>Year</th>
<th>Billions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>$52</td>
</tr>
<tr>
<td>1977</td>
<td>$174</td>
</tr>
<tr>
<td>1987</td>
<td>$517</td>
</tr>
<tr>
<td>1997</td>
<td>$1,135</td>
</tr>
<tr>
<td>2007</td>
<td>$2,295</td>
</tr>
<tr>
<td>2017</td>
<td>$3,492</td>
</tr>
<tr>
<td>2027</td>
<td>$5,963</td>
</tr>
</tbody>
</table>

Source: CMS.gov
Per capita healthcare spending in the US is expected to grow from $11,597 in 2018 to $12,118 in 2020.

Source: Statista
US Healthcare Spending by Categories (%)

Nursing Care, Prescription Drugs, Physician/Clinical Care and Hospital Care are expected to show greatest % increase in healthcare spending in the US during 2024-2028.

Source: S&P
# US Healthcare Spending – Key Facts

US per capita healthcare spending has increased over 2018; however, the quality of healthcare is still not as expected

<table>
<thead>
<tr>
<th>Estimated total healthcare spending in 2019</th>
<th>Total US Federal State and Local Govt. healthcare spending in 2019</th>
<th>Growth in spending over 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD3.8 tn</td>
<td>USD1.7 tn</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated growth in spending during 2018 - 2027</th>
<th>Spending goes to hospitals, doctors, and clinical services</th>
<th>Estimated per capita healthcare spending in 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5%</td>
<td>59%</td>
<td>USD11,597</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GDP share related to healthcare spending</th>
<th>Of all medical spending goes to waste</th>
<th>Number of deaths due to misdiagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.7%</td>
<td>25%</td>
<td>40,000 – 80,000</td>
</tr>
</tbody>
</table>

Source: CMS.gov, US Federal Government Spending, Fortune

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Benefits of Computer Vision in Healthcare

CV is allowing medical practitioners to offer more precise, on-time, and cost-effective diagnostic and monitoring services that are enhancing the overall healthcare service delivery model.

**Precise Diagnoses**
- Accurate diagnoses of image data
- Reduce redundant surgical procedures and expensive therapies

**Timely Detection of Illness**
- Early detection of symptoms
- Timely treatment
- Increased probability of survival

**Health Monitoring**
- Enables doctors to remotely monitor, analyze health metrics, and take faster and better medical decisions

**Reduce Drug Development Costs**
- Enables pharmaceutical companies to increase throughput

**Improved Patient Care**
- Saves time in analyzing reports and images
- Allows doctors to spend more time with patients and provide more personalized care

Source: Med City News, Logikk
Computer Vision in Healthcare Applications
The continuous involvement of CV in healthcare has created new areas of applications

**Medical Imaging/Diagnostics**
- Radiology
- Pathology
- Oncology
- Dermatology
- Ophthalmology
- Cardiology
- Neurology
- Lab Diagnostics
- Genomics

**Drug Discovery**
- Visualization
- High Throughput Target Simulation
- Cellular Level Analysis

**Remote Monitoring & Care**
- Facial Analytics
- Pharma/Clinical Trial Adherence
- Child Monitoring
- Physical Therapy
- Pain Management

**Remote/Robotic Surgery**
- AR/VR/Mixed Reality
- Remote Surgical Applications
- Other Application: Cardio/Lung/Hernia

Source: Health Tech Magazine
Global Computer Vision in Healthcare Market by Application

CV in healthcare is expected to show continuous growth with medical imaging and diagnostics to contribute the most towards overall market growth.

Source: Tractica, Maximize Market Research
Despite the pandemic (or perhaps due to it), 2020 might see the highest venture capital infusion into Digital Health ever!

**Digital health venture funding** 2016-H1 2020

Source: Rock Health Funding Database

Note: Only includes U.S. deals >$2M; data through June 30, 2020
VC funding for CV in healthcare increased significantly from $218 mn in 2018 to $493 mn in 2019.
# Cutting Edge Computer Vision Healthcare Companies

Zebra Medical Vision, Caption Health and Sight are few of the trailblazing CV startups

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zebra Medical Vision</td>
<td>Bringing AI and Deep Learning to pathology to deliver accurate diagnoses</td>
</tr>
<tr>
<td>Caption Health</td>
<td>AI for radiology (CT and X-ray) to detect abnormalities and speed time to diagnoses for everything from bone density to cranial bleeding</td>
</tr>
<tr>
<td>Arterys</td>
<td>AI and Cloud Supercomputing for fast, accurate image analysis especially for cardiovascular and lung conditions</td>
</tr>
<tr>
<td>Sight</td>
<td>Brings affordable, scalable and accurate blood diagnostics to the point-of-care, thereby accelerating better patient outcomes and improving healthcare for all</td>
</tr>
<tr>
<td>Caption Health</td>
<td>AI-enabled acquisition and interpretation of ultrasounds</td>
</tr>
<tr>
<td>Tissue Analytics</td>
<td>Securely stream patient photographs and wound analysis on the desktop</td>
</tr>
<tr>
<td>Butterfly</td>
<td>Designer of a medical imaging device that reduces the cost of real-time and 3D imaging and treatment</td>
</tr>
<tr>
<td>HeartFlow</td>
<td>Non-invasive coronary artery disease detection using 3D image rendering</td>
</tr>
<tr>
<td>AiCure</td>
<td>Machine vision based facial analysis to identify patient adherence</td>
</tr>
<tr>
<td>VirtuSense</td>
<td>Machine vision to analyze movement and falls for patients/seniors</td>
</tr>
<tr>
<td>Netcera</td>
<td>Using contact free sensing technology for remote monitoring</td>
</tr>
</tbody>
</table>

Source: Crunchbase
## Centralized vs. Remote Data Acquisition

### Centralized Data Acquisition & Analytics

<table>
<thead>
<tr>
<th>Lab Diagnostic</th>
<th>Cardiology</th>
<th>Ultrasound</th>
<th>DNA Testing</th>
<th>MRI</th>
<th>CT Scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beckman Coulter</td>
<td>NIHON KOHDEN</td>
<td>illumina</td>
<td>Siemens</td>
<td>Siemen</td>
<td>Siemens</td>
</tr>
<tr>
<td>freenome</td>
<td>zebr</td>
<td>ImFusion</td>
<td>GenomeSmart</td>
<td>iCometrix</td>
<td>Aidoc</td>
</tr>
<tr>
<td>PathAI</td>
<td>KenSci</td>
<td>EchoNous</td>
<td>deep genomics</td>
<td>Arterys</td>
<td>iz.ai</td>
</tr>
<tr>
<td>HeartFlow</td>
<td>Intelligent Ultrasound</td>
<td>SOPHiA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Point of Care/Remote Data Acquisition & Analytics

<table>
<thead>
<tr>
<th>Ophthalmology</th>
<th>Crib Cam</th>
<th>Remote Monitoring</th>
<th>Lab Diagnostics</th>
<th>Dermatology</th>
<th>Bio-monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>RETINA.ai</td>
<td>BabbyCam</td>
<td>VirtuSense</td>
<td>sight</td>
<td>FIRST DERM</td>
<td>TISSUE ANALYTICS</td>
</tr>
<tr>
<td>Retina Labs</td>
<td>nanit</td>
<td>carezapp</td>
<td></td>
<td>SkinVisor</td>
<td>Arthronica</td>
</tr>
<tr>
<td>eyeEm</td>
<td>ufy</td>
<td>CarePredict</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share OPTOMETRY</td>
<td>Levana</td>
<td>AiCare</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Company Websites, Secondary Research
Caption Health, Nanit, Healthy.io, AiCure are some of the major diagnostics solution providers that are more inclined towards CV-driven innovation.

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Deal Date</th>
<th>Company Stage</th>
<th>Overview</th>
<th>Recent Funding ($M)</th>
<th>Pre-money Valuation ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caption Health</td>
<td>07/15/2020</td>
<td>Series B</td>
<td>AI and deep learning-based medical imaging software for intelligent video analysis to diagnose heart diseases</td>
<td>$53.00</td>
<td></td>
</tr>
<tr>
<td>Nanit</td>
<td>05/12/2020</td>
<td>Series B1</td>
<td>AI and computer vision-based monitoring devices designed to track baby sleep behavior and patterns</td>
<td>$21.00</td>
<td>$42.00</td>
</tr>
<tr>
<td>Arterys</td>
<td>05/06/2020</td>
<td>Series C</td>
<td>Medical imaging analytics platform with AI to visualize and quantify blood flow in the body using an MRI</td>
<td>$28.00</td>
<td>$16.00</td>
</tr>
<tr>
<td>Owkin</td>
<td>05/06/2020</td>
<td>Series A</td>
<td>ML tool to augment medical and biological research integrating biomedical images, genomics and clinical data</td>
<td>$43.00</td>
<td></td>
</tr>
<tr>
<td>Arterys</td>
<td>04/28/2020</td>
<td>Series C</td>
<td>SaaS-based analytics and medical imaging diagnostics used to visualize and quantify blood flow in the human body</td>
<td>$28.00</td>
<td></td>
</tr>
</tbody>
</table>

Source: CapitalIQ
Best Funded Companies in Computer Vision Healthcare (2/2)

Caption Health, Nanit, Healthy.io, AiCure are some of the major diagnostics solution providers that are more inclined towards CV-driven innovation

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<tr>
<th>Company Name</th>
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<th>Overview</th>
<th>Recent Funding ($M)</th>
<th>Pre-money Valuation ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AiCure</td>
<td>11/07/2019</td>
<td>Series C</td>
<td>AI-based intelligent software to capture and understand video, audio, and behavioral data for disease treatment</td>
<td>$24.50</td>
<td></td>
</tr>
<tr>
<td>Healthy.io</td>
<td>09/11/2019</td>
<td>Series C</td>
<td>Computer vision and AI-based platform to capture test strip images using smartphone camera, analyze chemical color of urine test strips and give instant reports</td>
<td>$60.00</td>
<td>$192.42</td>
</tr>
<tr>
<td>Zebra Medical Vision</td>
<td>08/01/2019</td>
<td>Series C</td>
<td>ML-based medical imaging research and analytics platform to provide automated medical image diagnosis</td>
<td>$39.26</td>
<td>$94.31</td>
</tr>
<tr>
<td>Tempus</td>
<td>05/30/2019</td>
<td>Series F</td>
<td>Developer of a health care data analytics platform designed to improve patient outcomes</td>
<td>$200.00</td>
<td>$3,100.00</td>
</tr>
<tr>
<td>PathAI</td>
<td>04/17/2019</td>
<td>Series B</td>
<td>Developer of an AI-powered research platform for cancer diagnosis and treatment</td>
<td>$60.00</td>
<td></td>
</tr>
</tbody>
</table>

Source: CapitalIQ
<table>
<thead>
<tr>
<th>Investors</th>
<th>Key Portfolio Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khosla Ventures</td>
<td>HealthTap, Zebra Medical Vision, Curai, Arpeggio Bioscience, Olive (RPA)</td>
</tr>
<tr>
<td>DCVC</td>
<td>Zymergen, Culture Bioscience, CloudMedx, ProteinQure, HumanDx, Caption Health</td>
</tr>
<tr>
<td>Andreessen Horowitz</td>
<td>TwoAR, Freenome</td>
</tr>
<tr>
<td>Google Ventures</td>
<td>Flatiron, Insitro, Verana Health, Owkin, Fathom (Medical Coding Automation), DxOptics, ImagenTechnologies, Recursion Pharmaceuticals, Atomwise</td>
</tr>
<tr>
<td>General Catalyst</td>
<td>Mindstrong Health, OM 1, Curai, Imprivata, Color, Roman Health, Avant-Grade Health, Aidin, Humedica, Prematics</td>
</tr>
<tr>
<td>General Atlantic</td>
<td>Change Healthcare, EviCore Healthcare, Eclipsys, MultiPlan, Envoy, Amedes Group, CitrusTech, Change Healthcare, Alignment Healthcare, Capario, OneOncology, eRx Network, MedUnite, Healthcare Technology Management Services, MeDIStar Group</td>
</tr>
<tr>
<td>Polaris</td>
<td>OM 1, Gauss Surgical, Imprivata, Phytel, Phreesia, Free &amp; Clear, Quartet Health, Partsource, Perpetual Motion, Prospex Medical, Sentillion, Strata Health Solutions, Wellsphere</td>
</tr>
</tbody>
</table>

Source: 3DS, Medical Device Network, Francisco Partners, WellSoft, Point Click Care, Secondary Research
**Key Portfolio Companies of Major Investors (2/2)**

General Atlantic, Bessemer Ventures, Khosla Ventures, and Google Ventures are some of the major investors in healthcare specific CV

<table>
<thead>
<tr>
<th>Investors</th>
<th>Key Portfolio Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digitix</td>
<td>Savonix, Tissue Analytics, Siris Medical, WellDoc</td>
</tr>
<tr>
<td>Canaan</td>
<td>Abyrx, Ambra, Anliva Biosciences, Arrakis Therapeutics, Arvinas, Corvium, Genome Medical, Glooko, Roman, Truveris, Vineti</td>
</tr>
<tr>
<td>Bessemer Ventures</td>
<td>AccuVein, Artemis Health, Bright Health, Collective Medical, Docent Health, Fractyl, Groups, Kymera Therapeutics, Nym, Qventus, Subtle Medical, TScan Therapeutics</td>
</tr>
</tbody>
</table>

Source: 3DS, Medical Device Network, Francisco Partners, WellSoft, Point Click Care, Secondary Research
Large data companies like Google, Amazon and Apple are making huge strides into healthcare as technological advancements have enabled digital healthcare to advance rapidly.

**Google**
- **Most active** big tech firm in healthcare AI initiatives
- Founded **Verily** in 2015
- Project Medical Digital Assist focused on **AI usage in physician assistance**
- Developed algorithm to **diagnose diabetic retinopathy** in images
- Acquired fitness activity tracker **Fitbit** for $2.1 billion
- **Partnered with biotech firms** C4 Therapeutics and AbbVie pharmaceuticals via Calico

**Amazon.com**
- **Corporate healthcare system** – Amazon Care
- Purchased online **pharmacy startup PillPack**
- Plans to sell **medical records reading software**
- Working on **cancer research and other healthcare related ventures** such as last-mile delivery

**Apple**
- Focus on **patient facing products** as well as streamlining **medical payments**
- Received **FDA clearance** for new heart monitoring Apple Watch feature **(EKG)**
- Implementing **Apple Health Records** system through **hospital partnerships**
- Acquired sleep monitor company **Beddit** (May 2017) and personal health data platform **Gliimpse** (2016)

Source: Google, Healthcare Weekly, CNBC, TheVerge
The healthcare industry presents tremendous business opportunity, encouraging other top tech companies to adopt healthcare innovation.

**Microsoft**
- Launched **health care division** in 2017 that focuses on **AI for patient care improvement**
- Alliance with Walgreens to develop **new health care innovations**
- Offering **healthcare focused solutions** through Azure suite

**Facebook**
- Collaborative research on applying **AI to MRI scans**
- Acquires **neural interface startup** CTRL-Labs for its mind-reading wristband
- Plans to launch "**Preventive Health**" tool to prompt users to get regular checkups

**Johnson & Johnson**
- Acquired Auris Health’s **robotic platform technology** used in diagnostic and lung therapeutic procedures
- Partnered with accelerator Founders Factory with focus on startups in the **consumer healthcare space**

**Intel**
- Intel Capital invested in Lumiata, which improves quality of hospital care through **data and predictive analytics**
- Invested in EchoPixel, which is developing tools to enable **non-invasive colon cancer screening**

**Best Buy**
- Acquired **predictive healthcare** technology business of BioSensics
- Bought **seniors-focused health services** company Critical Signal Technologies and GreatCall, emergency concierge & monitoring services provider

**Uber**
- Launched Uber Health: **non-medical-emergency transportation service**

Source: Microsoft, Becker Shopital Review, The Verge, Telegraph, Company Websites
As shift towards new technologies gains momentum, the FDA has worked to modernize their regulatory approach to facilitate innovation to improve the healthcare system.

**Proposed regulatory framework for dynamic AI systems** to ensure realization of the full potential of the technology.

**Approval of 106 novel devices** in 2018, including artificial intelligence based technologies for diabetic retinopathy diagnosis.

**Creation of a Center for Excellence for Digital Health** to complement the advances in software-based devices.

### Digital Health Innovation Action Plan 2017

- Regulatory **exclusion of certain medical software** and lifestyle mobile apps under the revised 21st Century Cures Act
- Development of a **precertification program** for faster launches for certain products (including AI based products)
- Growing FDA’s **medical software technology expertise** through talent hiring

Source: Technology Review, MedTech Boston, FDA, Healthcare IT News
Future Trends

FDA will continue to embrace **Software as a Medical Device (SaMD)** to approve diagnoses

**Precision medicine**: Closed loop from drug discovery to therapy, adherence/compliance and efficacy

**Automation**: Oncology/Radiology/Pathology will become increasingly automated as AI/DL algorithms continue to improve

Portable devices and smart phones or smart phone-based peripherals will continue to “consumerize” healthcare

Combination of **AI/ML/DL** + high resolution imaging/capture will continue to **democratize CV**, especially in lab diagnostics

**5G will enable distributed computing** and push the real-time analytics envelope
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