



# Wearable Patch Vital Sensors and their Business Opportunities

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# AffordSENS Corporation

- **Start up:** at November/2013

- **Aim :** return the achievements

to our society from Maenaka Human-Sensing Fusion Project ( supported by Japan Science and Technology Agency –JST- )and contribute to realize the healthy life for everybody, at anytime and anywhere

- **Vitalgram® Technology :**

- Sensor device technology for vital sensing
- Vital sensor with flexible and stretchable wiring
- Vital sensor which adheres to skin
- Low power consumption technology
- RF wireless technology
- Embedded software technology
- iOS application development

- **Buisness field :** research and development support

- Design, development, prototyping and consulting of healthcare monitoring devices  
**Vitalgram® ECG** patch type multi vital sensor, **Vitalgram® multi EMG** sensor, **Vitalgram® muti channel EEG** sensor
- Customization and development : additional sensor, another wireless sensor system
- Design, development, prototyping and consulting of healthcare management system
- Design, development, prototyping and consulting of devices and systems for sensor network

- Head office : Kanagawa-ku, Yokohama

- R&D center : University of Hyogo, Shosha, Himeji

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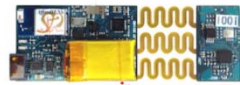
- URL : <http://www.AffordSENS.com>



Vitalgram® Technology



# Vitalgram<sup>®</sup> Technology



Wearable patch vital sensor

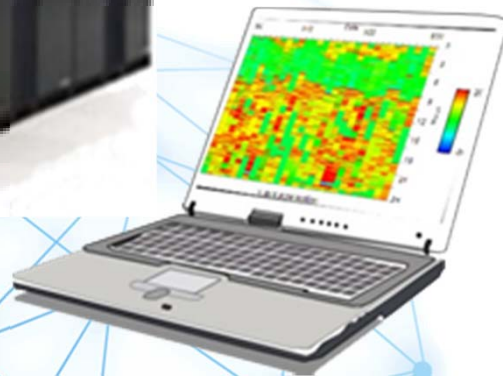


Bluetooth 4.0

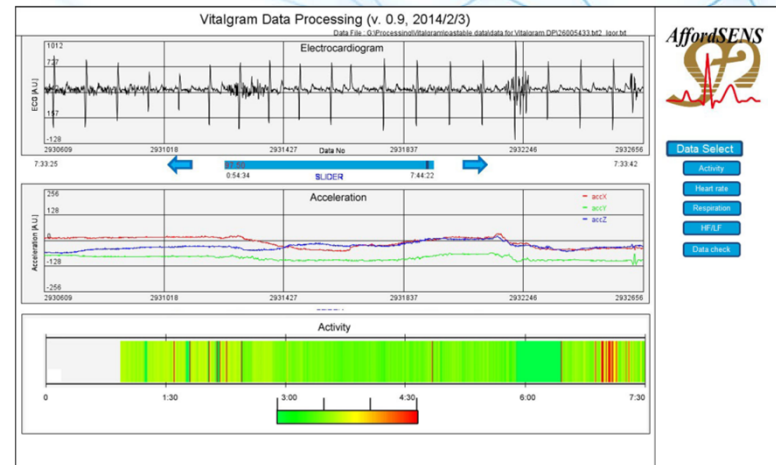


Real time data on an iOS terminal

Via Internet



data analyses on a cloud server



Vitalgram<sup>®</sup> Data Analysis



# Vitalgram<sup>®</sup> (Feature)

## Vitalgram<sup>®</sup> Rev.B

Main board :

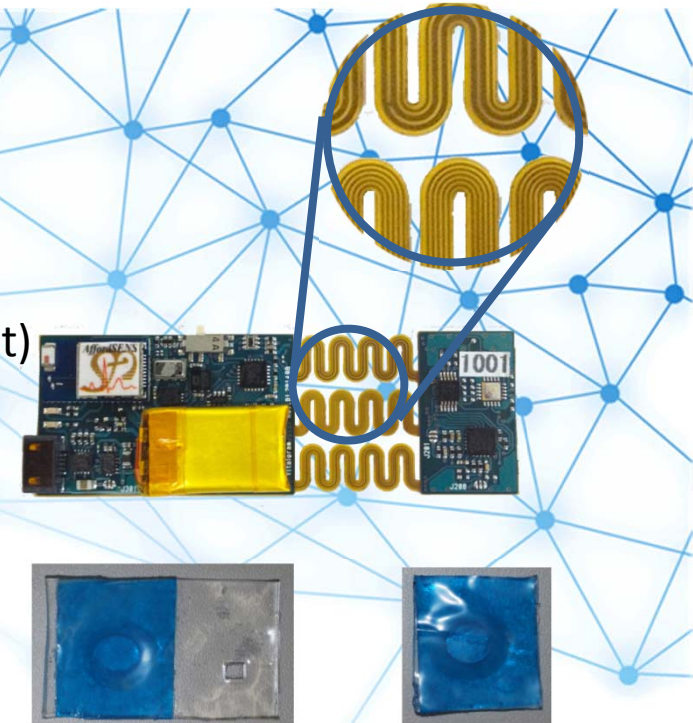
- 3-axis accelerometer (for posture and activity)
- pressure sensor (for height)
- temperature sensor (for environment temperature)
- humidity sensor (for environment humidity or sweat)
- brightness sensor
- skin surface temperature sensor(backside)
- Bluetooth 4.0 module, Li-ion battery, USB port  
(\* ) possible to work separately

Sub board :

- 2 sets of head amp and variable gain amplifier  
for ECG and reserved

Stretchable wiring (thanks Nippon Mektron Ltd.) :

- accordion Cu wiring formed  
on the polyimide film (compatible with FPC fabrication process)
- stretchable within 0 to 15% (max 60%),
- verified reliability under repeating stretch test (from 0 to 60%)



Disposable ECG Electrode:

- electrical and mechanical  
connection with adhesive  
PDMS film



# Vitalgram<sup>®</sup> Application

## 1. Guardian

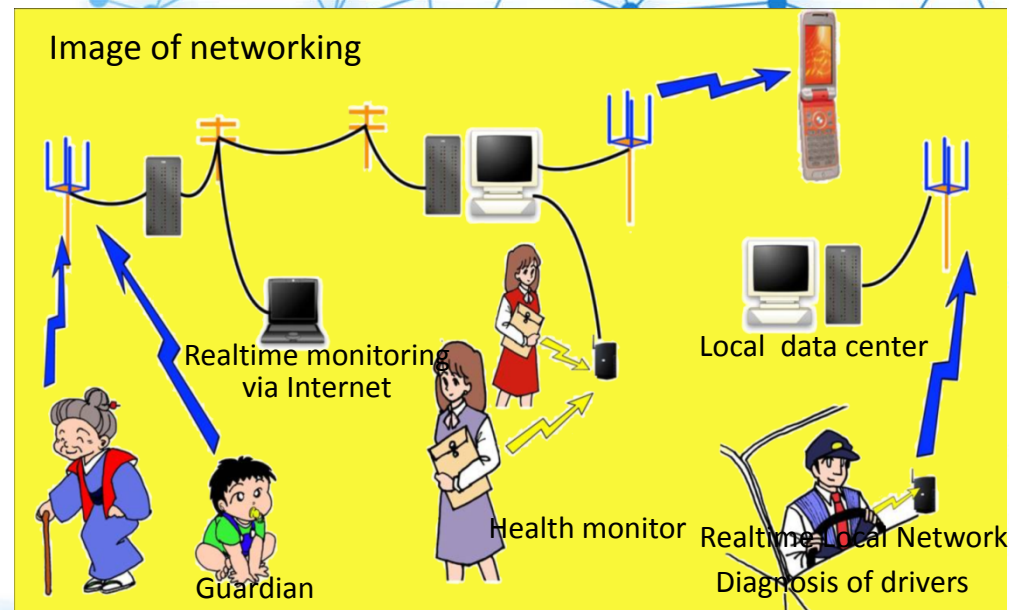
- A) For aged-people at a nursing home and infants at a kindergarten or a nursery school
- B) Nurse calling at a hospital
- C) Heatstroke prevention at a construction site etc.

## 2. Healthcare monitoring

- A) Daily physical condition management
- B) Stress degree check and fatigue degree check
- C) Disease prevention and health promotion through measurement of a long life rhythm

## 3. Remote home care and other application

- A) Home rehabilitation for heart failure patients
- B) Training management at Gym
- C) Correcting form of an athlete (ex. Pitching, catching and batting form of baseball players)



at anytime and anywhere

# Application for aged people : Cooperation with nurse calling system



### 高齢者向け施設への設置例

施設利用者は必要な時に、  
医師、看護師、介護スタッフ、家族と  
iPadを利用して通話することができます。  
また、医療スタッフ、ご家族からは24時間  
利用者を見守ることが出来ます。  
医療スタッフと、ご家族も簡単に連絡を  
取り合うことができます。

ITTS Corp.

### Targets:

- hospital
- nursing home
- housing of the aged
- hospice
- sparsely populated area

### Feature:

Alternative nurse call button  
Existing Nurse call system  
using mobile terminals  
**+ Vital monitor with  
emergency call function**

### Emergency call:

- fall
- abnormal heart rate
- abnormal body temperature  
going up
- abnormal sweat

### Requirements:

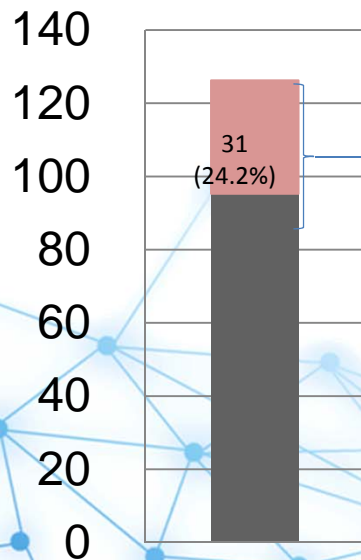
- highly reliable in particular  
Bluetooth radio connection
- wearability (for dementia  
patients)



# Among the over 65 people, 16% are living alone and also 16% are receiving long-term care service(s)

Total Population

(Million)



2012

■ Above 65

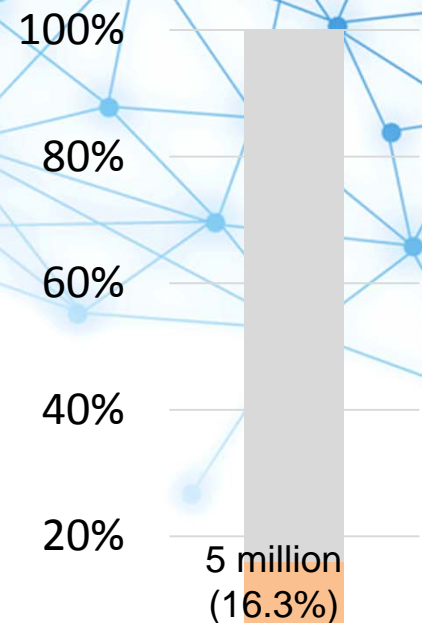
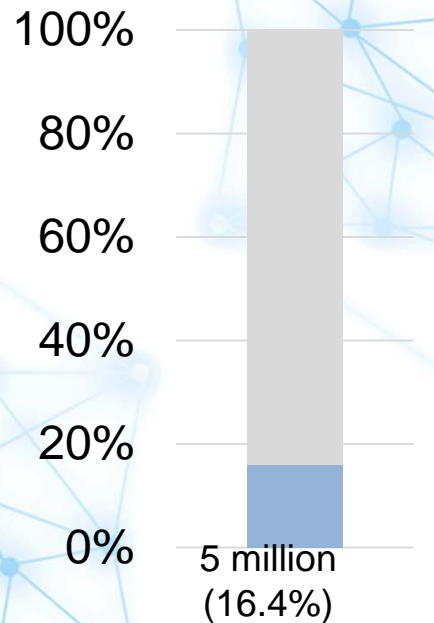
■ Below 65

Breakdown of over 65 people

Type of residency

Help of long-term care

Total=31 million



■ Living with family/other ■ Living alone

■ Receiving ■ Not receiving

Source: National Institute of Population and Social Security Research, Ministry of Health, Labour and Welfare

Provided by K.Ueno et al. at Harvard BS



# Which market should we target ?

	Description	Long-term care insurance	# of customers (000)	Share (%)		
1	Certified home care services (指定居宅サービス)	• Deliver care services to customers' homes • Dining, shower, rehabilitation, etc	applicable	3,284	65.3	} Potential target
2	Long-term care insurance facilities (介護保険施設)	• Provide residential care services to customers who require intensive care	applicable	861	17.1	
3	Nursing home (老人ホーム/老人福祉施設)	• Provide residential care services to relatively active elderly	not applicable	359	7.1	
4	Elderly service apartment (高齢者向けサービス付住宅)	• Provide barrier-free apartment with daily care services	not applicable	133	2.6	
5	Group home/ Care home (グループホーム・ケアホーム)	• Provide group therapy care for mentally/physically ill patients	not applicable	81	1.6	
6	Other (その他)	• Special facility for dementia, etc	mostly applicable	310	6.2	
	Total			5,030	100.0	

Source: Ministry of Health, Labour and Welfare, 全国有料老人ホーム協会

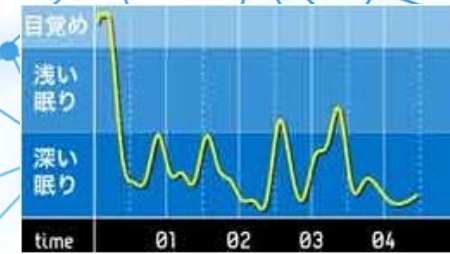
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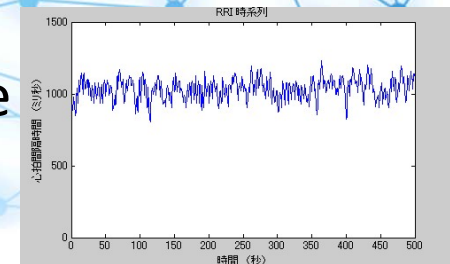


# Application for healthy persons : Health care management and predicting disease

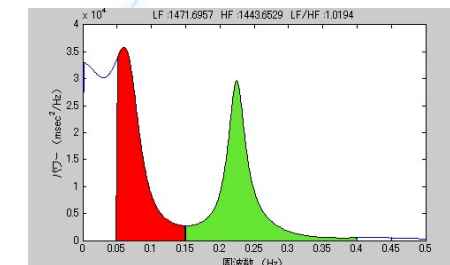
1. Sleep quality evaluation  
evaluate sleep quality by measuring REM and non-REM sleep
2. Stress check  
Stress measurement by autonomic nerve activation degree (evaluation from the balance of the strain of sympathetic nerve and the parasympathetic nerve)  
HRV analysis (heartrate beat fluctuation analysis method)
3. Epilepsy attack foresight  
by HRV analysis
4. Predicting heart failure  
and detecting arrhythmia



REM and non-REM sleep

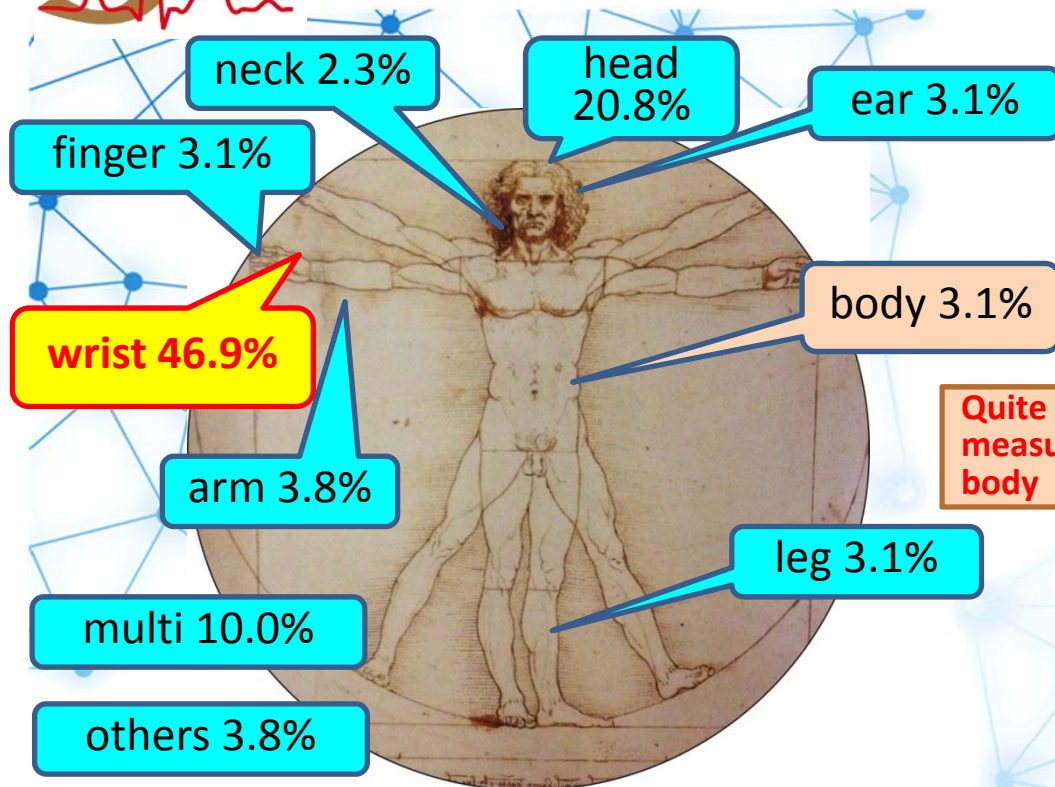


Heart rate time-series behavior



Frequency component of heart rate power spectrum

# Why patch sensors ?



Source: MMRI  
(classify 130 wearable products)

1. Various vital signs such as ECG (heart rate), body temperature, blood pressure, SPO2 etc. in a human-body should be measured at the suitable place.



Quite difficult to measure a human body

2. Many small patch sensors can be attached on the suitable spots at the same time although lack of life style compatibility.
3. The collected data by patch sensors are quite reliable without the influence of movements .
4. Therefore we can wear them without feeling uncomfortable and with living a daily life.



# Wearable devices need to meet basic criteria for adaptation and sustained use

## Clear Value Proposition

- Is the value proposition unique and clear?
- Can the customer understand the value to select the product?

## Design / Aesthetics

- Wearable products are visible, hence must appeal visually.
- Is the accompanying mobile app well designed?

## Fit / Comfort

- Does the product provide sizes to fit a wide range of users?
- Must be comfortable to wear at all times.

## Quality / Reliability

- Is the product robust enough to endure wear and tear?

## User Experience

- Is it intuitive, seamless, meaningful, and easy to use?
- Is the setup experience frictionless?
- Can the data be accessed by other apps?

## Lifestyle Compatibility

- How much lifestyle change does the device require?

Source: Endeavour Partners

*Provided by K. Ueno et al. at Harvard BS*



# How should we differentiate from other devices ?

## Smartwatches



## Activity trackers



## Patch sensors



Criteria	Smartwatches	Activity trackers	Patch sensors
<b>Clear Value Proposition</b>	<ul style="list-style-type: none"> <li>• Many applications for mass users</li> </ul>	<ul style="list-style-type: none"> <li>• Focused value on activity tracking</li> </ul>	<ul style="list-style-type: none"> <li>• Focused value on health monitoring</li> </ul>
<b>Design / Aesthetics</b>	<ul style="list-style-type: none"> <li>• Option for color variation</li> <li>• Interchangeable bands</li> <li>• Function as a fashion item</li> </ul>	<ul style="list-style-type: none"> <li>• Limited design and color</li> <li>• Function less as a fashion item</li> </ul>	<ul style="list-style-type: none"> <li>• Not so cool</li> </ul>
<b>Fit / Comfort</b>	<ul style="list-style-type: none"> <li>• Adjustable bands</li> <li>• Not suitable for night use</li> </ul>	<ul style="list-style-type: none"> <li>• Some trackers can be adjusted</li> <li>• Suitable for night use</li> </ul>	<ul style="list-style-type: none"> <li>• Suitable for night use</li> </ul>
<b>Quality / Reliability</b>	<ul style="list-style-type: none"> <li>• No significant recall</li> </ul>	<ul style="list-style-type: none"> <li>• Fitbit recall: Skin irritation, Feb 2014</li> <li>• Jawbone recall: malfunction, Dec 2011</li> </ul>	<ul style="list-style-type: none"> <li>• Disposable ECG electrode patches are approved for medical use</li> </ul>
<b>User Experience</b>	<ul style="list-style-type: none"> <li>• Interface, applications, and connectivity with smartphones enables a richer experience</li> </ul>	<ul style="list-style-type: none"> <li>• Depends mostly on the mobile app for user experience</li> </ul>	<ul style="list-style-type: none"> <li>• Depends mostly on the mobile app for user experience</li> </ul>
<b>Lifestyle Compatibility</b>	<ul style="list-style-type: none"> <li>• For watch users, smartwatches fit into the users lifestyle</li> </ul>	<ul style="list-style-type: none"> <li>• Need to "take care" of the tracker with charging, syncing, etc..</li> </ul>	<ul style="list-style-type: none"> <li>• We have no experience to wear patches except band-aids.</li> </ul>

Partially provided by K.Ueno et al. at Harvard BS



# Strategic options for healthcare and monitoring devices for healthy persons

## Key trends in wearable device industry

- Competition in wearable device industry is getting harsh as many new entrants come to the market
- Although wearable devices are getting prevalent, there are adoption issues
  - Customers stop using the device if it doesn't fulfill the basic criteria
- With integrated functions and better fit to consumer needs, smartwatches will take over other wearable devices' market shares

## Strategic options for healthcare wearable devices

- 1 **Different value**  
Provide superior healthcare functions which other wearable devices cannot provide
- 2 **Focused value**  
Focus on specific value and provide cheaper products with better business model
- 3 **Different target**  
Target people who don't own/use other types of wearable devices

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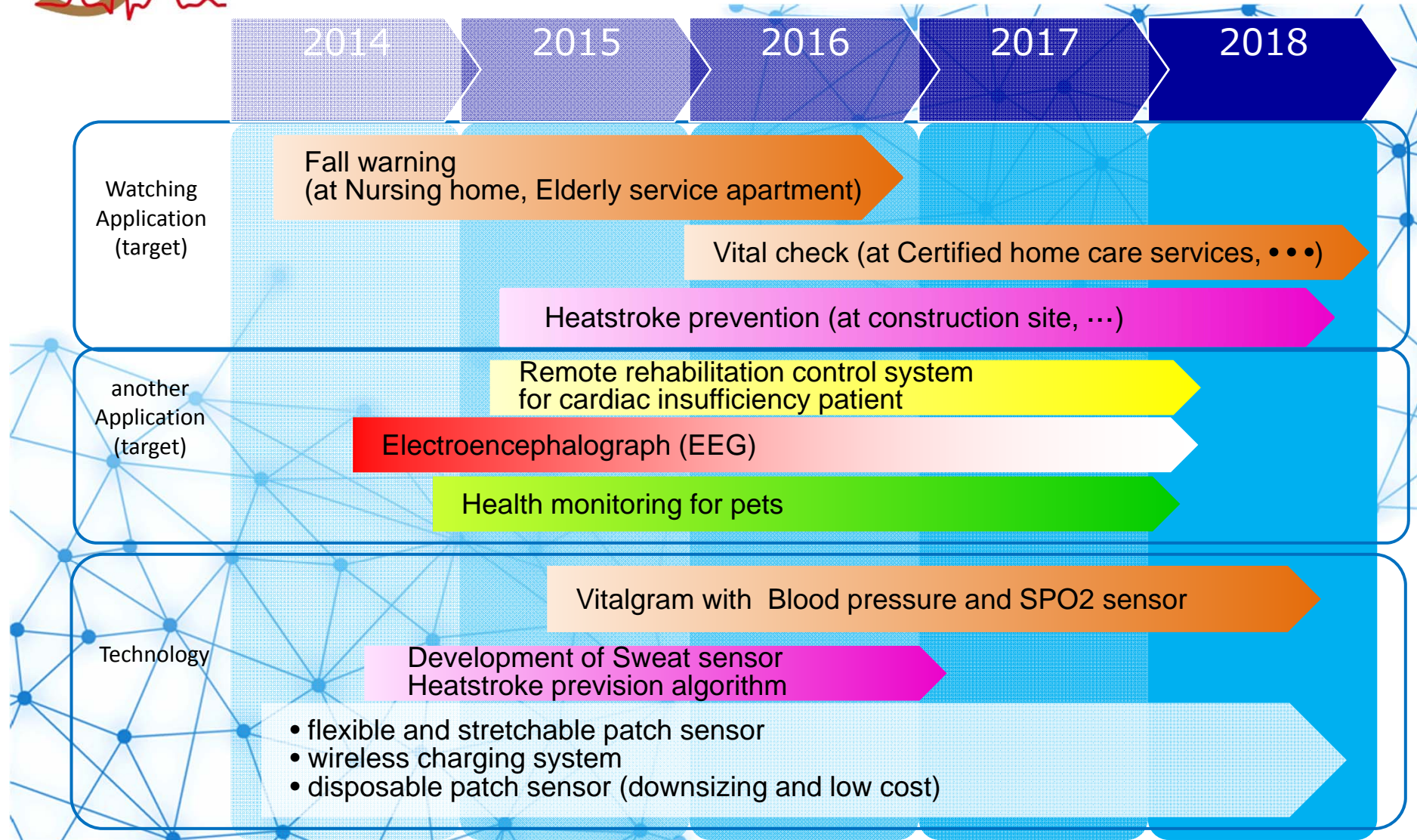
# For examples : Market opportunities for healthcare and monitoring devices

		Target size (in Japan)	Alignment with strategic options		
			Different value	Focused value	Different target
a	Safety monitoring at nursing home	820,000			✓
b	Blood pressure monitoring for hypertension patients	9,000,000	✓	✓	
c	Glucose level monitoring for diabetes patients	2,700,000	✓	✓	
d	Electrocardiogram monitoring for arrhythmic patients	1,000,000	✓	✓	
e	Emergency report for heart attack	---	✓	✓	
f	Calorie monitoring for dieters	23,000,000	✓	✓	
g	Health and location monitoring for children	2,000,000			✓
h	Pregnancy support for women	500,000 (fertility treatment)		✓	
i	Health and location monitoring for pets	20,000,000+ (dogs and cats)			✓

Provided by K. Ueno et al. at Harvard BS



# Vitalgram<sup>®</sup> road map





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