Ambient Assisted Living (AAL) setup to determine the wellness of a person living alone in their own home

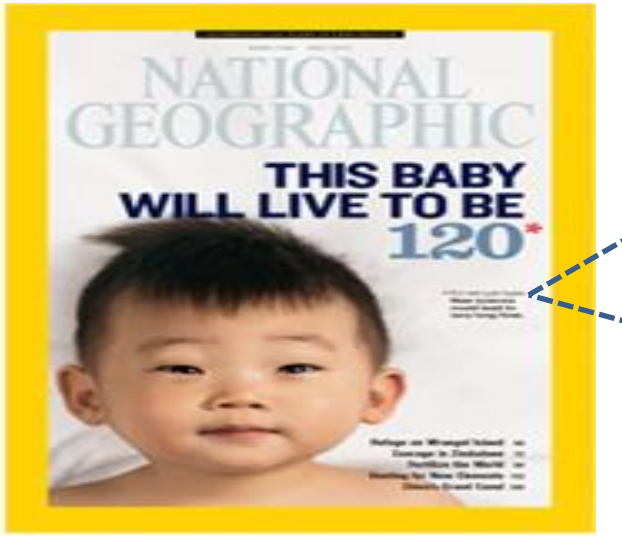


Dr. N. K. Suryadevara

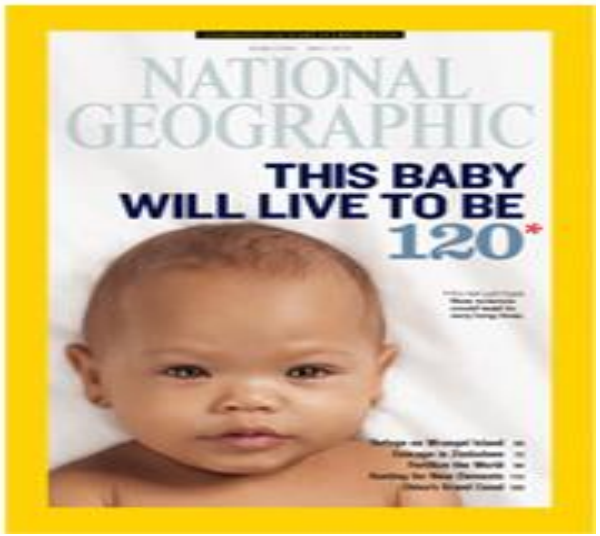
Senior Member IEEE
Professor and Head-Computer Science & Engineering
Geethanjali College of Engineering & Technology
Hyderabad-India

Good News









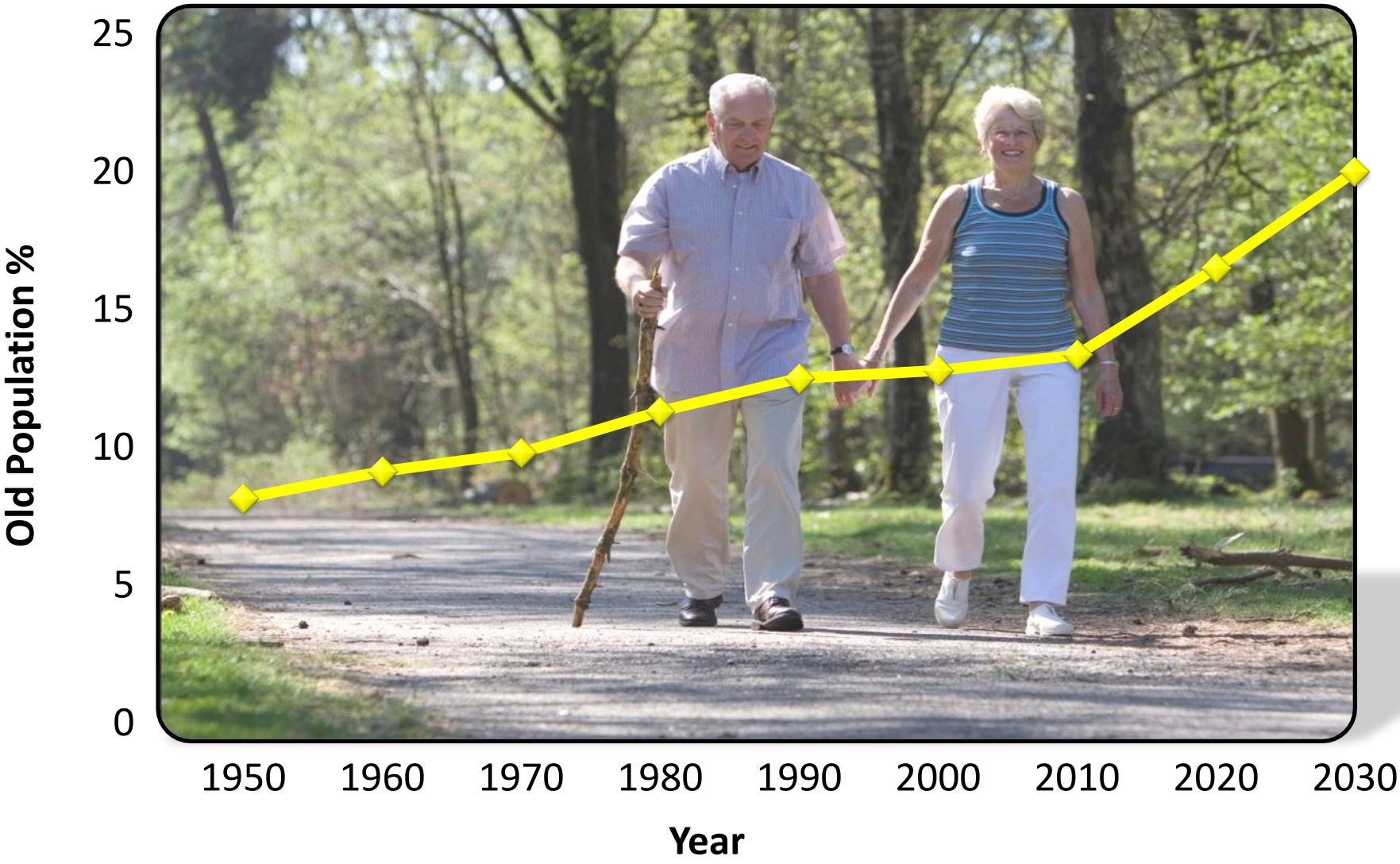
It's not just hype
New Science could lead to very long lives



This Baby Will Live to Be 120. National Geographic May 2013

This Baby Could Live to Be 142 (TIME) March 2015

Importance of Research



Independent Life



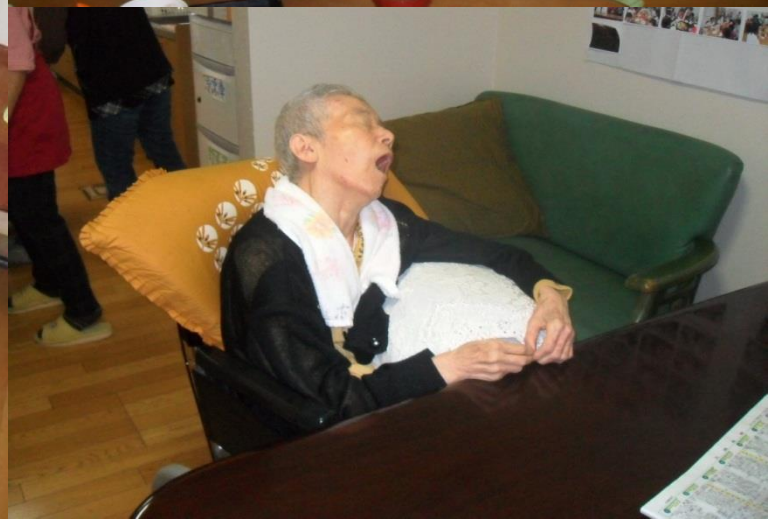
?



Need Assistance…….







How does someone die alone in their home without anyone realising?



Life of learning: Lewis Clarkson discovered his passion for learning late in life but wasted no time in gaining qualifications through extramural study at Massey University.



Dinner discussions: Mr Clarkson at home in Christchurch.

Photos: SUPPLIED



Resting place: The Crewe Cres house where Lewis Clarkson was found dead after a neighbour noticed flies gathering at a window.

Photo: DAVID UNWIN/FAIRFAX NZ

Their Needs

Help with
Activities of Daily Living (ADL)



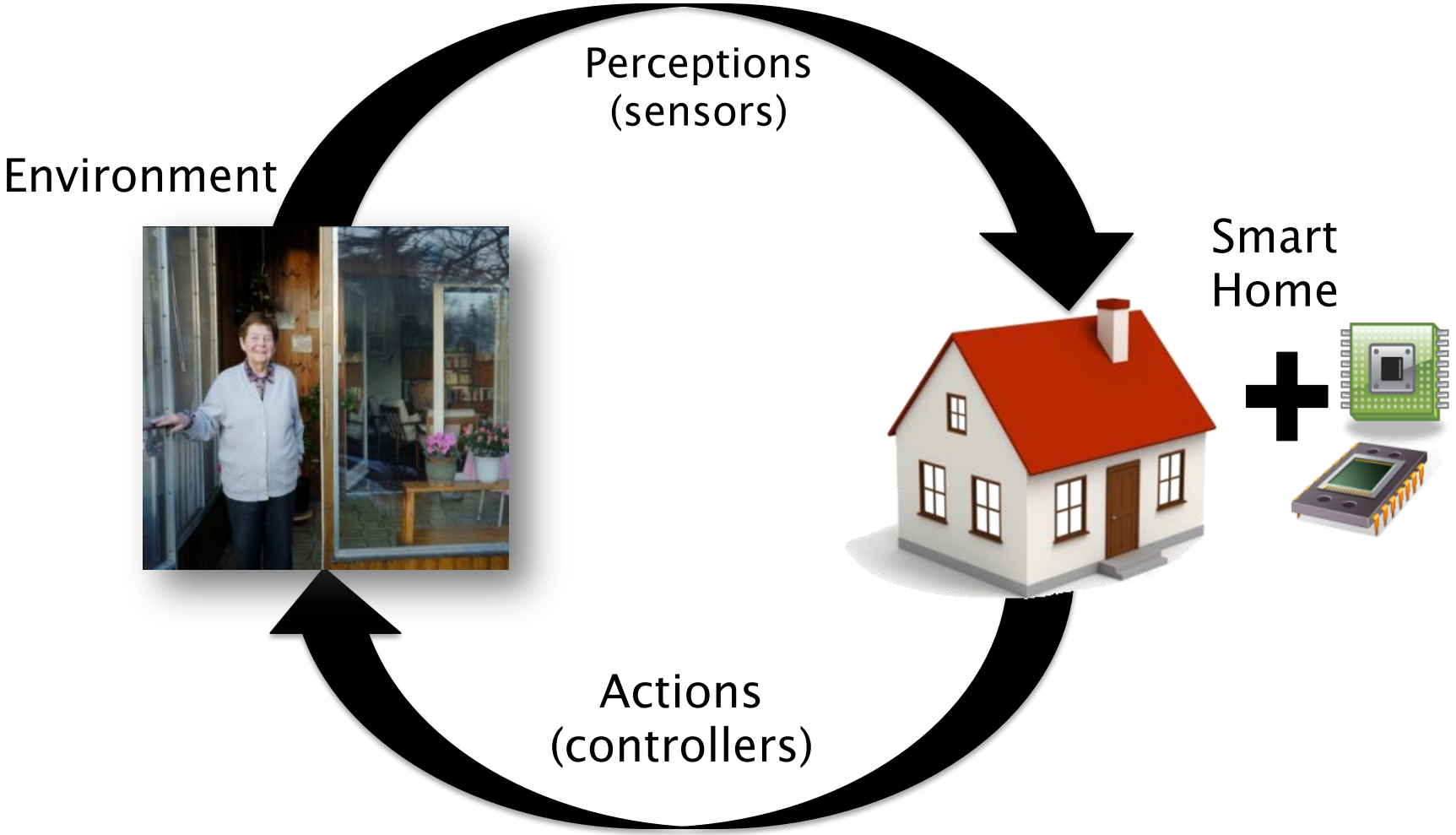
Health Monitoring



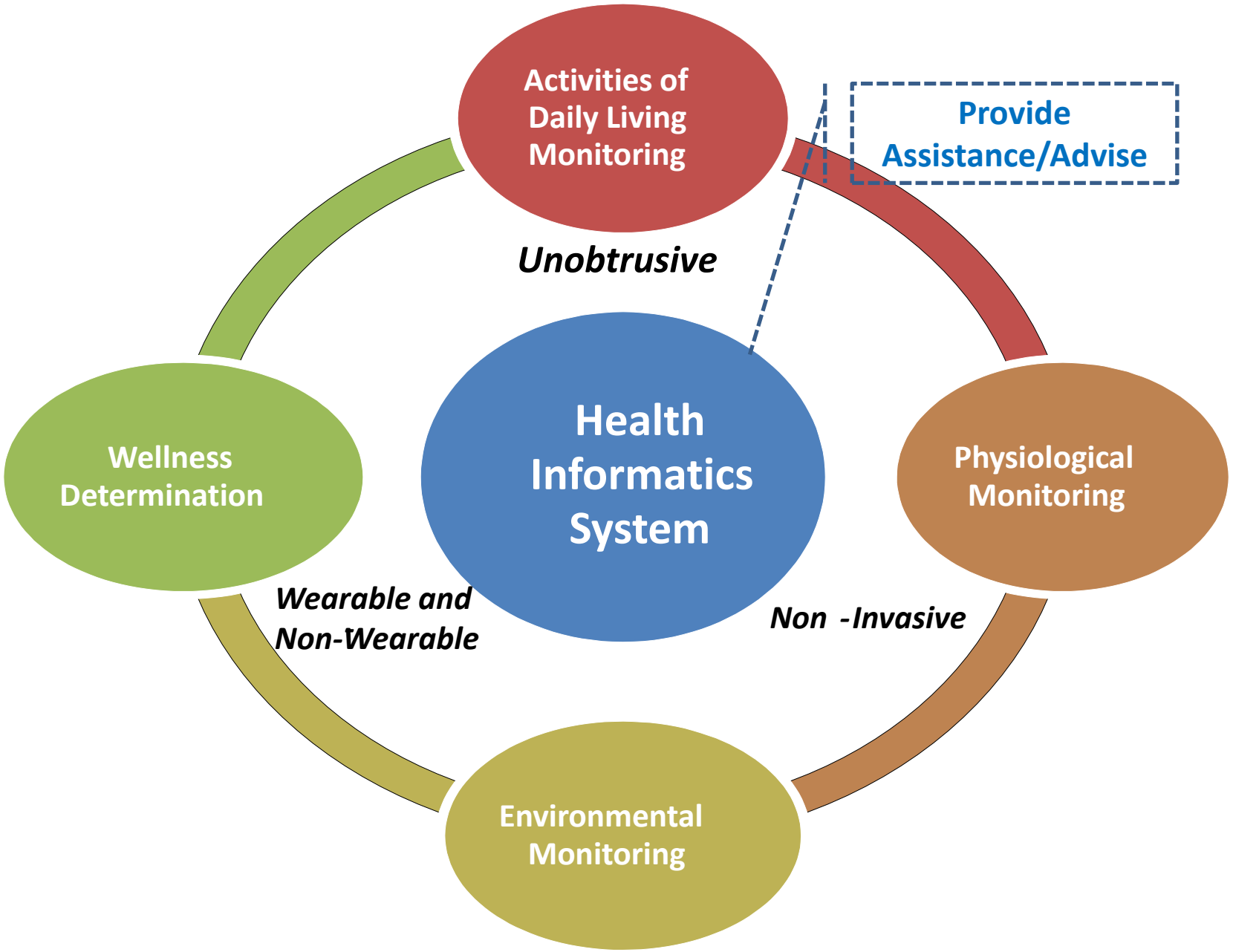
Reducing the burden from Caregiver



Ambient Assisted Living Setup
Smart Home Monitoring System



My Research


Activities of Daily Living Monitoring
Provide Assistance/Advise
Unobtrusive
Wellness Determination
Health Informatics System
Physiological Monitoring
Wearable and Non-Wearable
Non -Invasive
Environmental Monitoring

Health Informatics System collects more data

- ❖ **Plenty of Data Collection methods/tools**
- ✓ **More resources are required for Analyzing the data**
  - ➢ Proper Information can be gained from the analysis (translation) of data
  - ➢ Important indications for proper decision-making
  - ➢ Notify policy development

Our Solution:

Web-based reporting tool to analyze and infer right decisions

My Research

AAL Services
(Energy Consumption)
(Human Physiological)

Recognition of Human ADL's

Human Wellness Determination
β_1, β_2

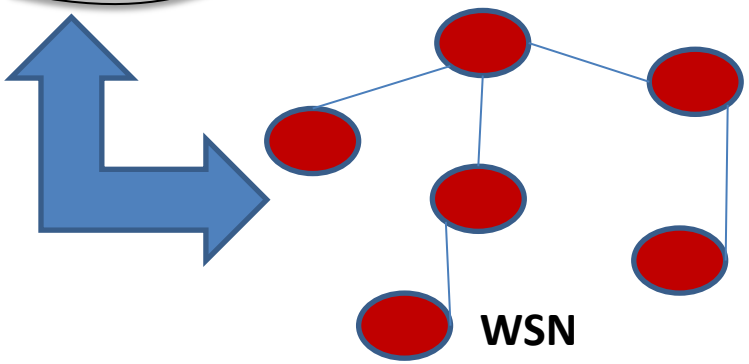
Domestic Objects usage Trend through Time Series Data Mining

Smart Home Monitoring System

Sensors Data Acquisition

Remote Interoperability

Internet



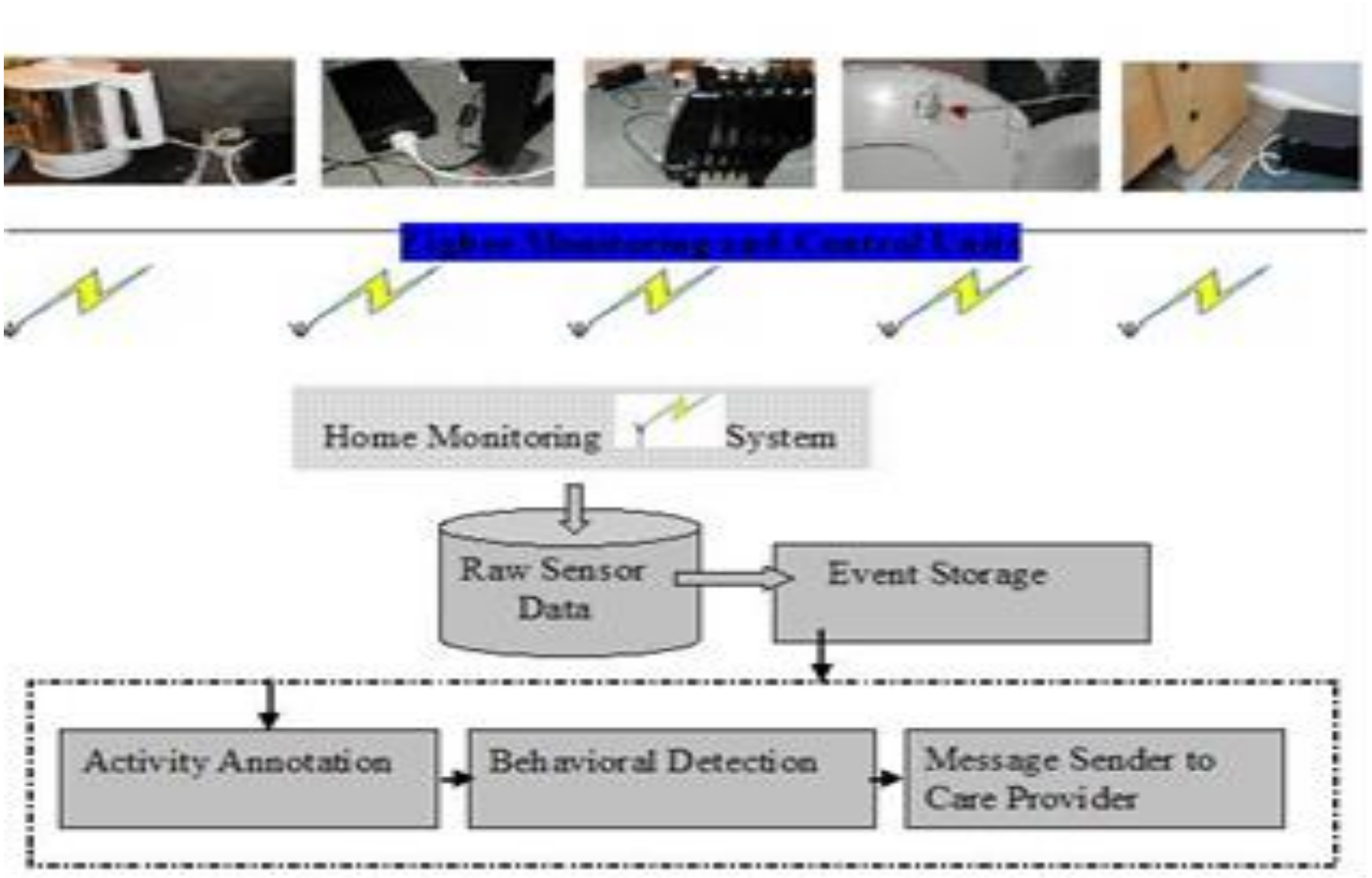
Data Base

Health Care Provider/ Relatives/ Tele-Care Services

Better Solution-Technologies



Sensors Integrated with Everyday Objects

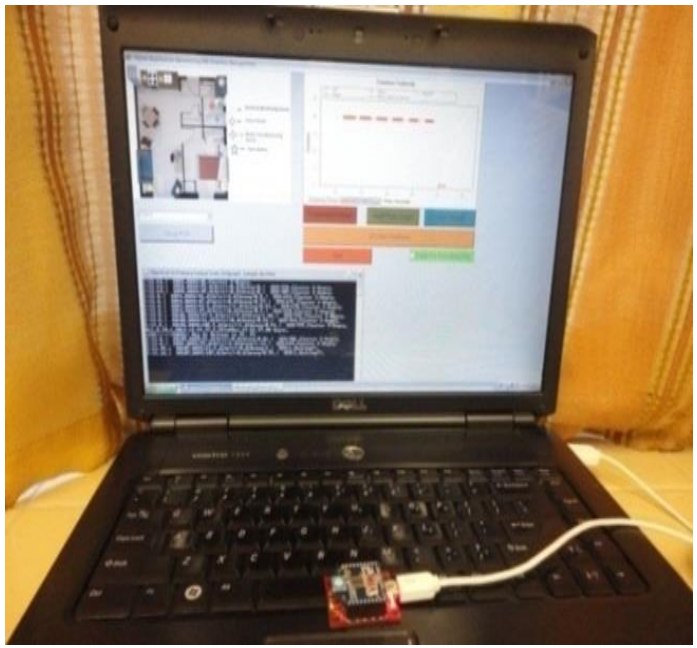


Sensing Units-HMS





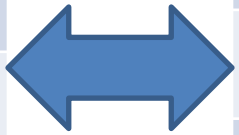






Monitoring Basic ADL

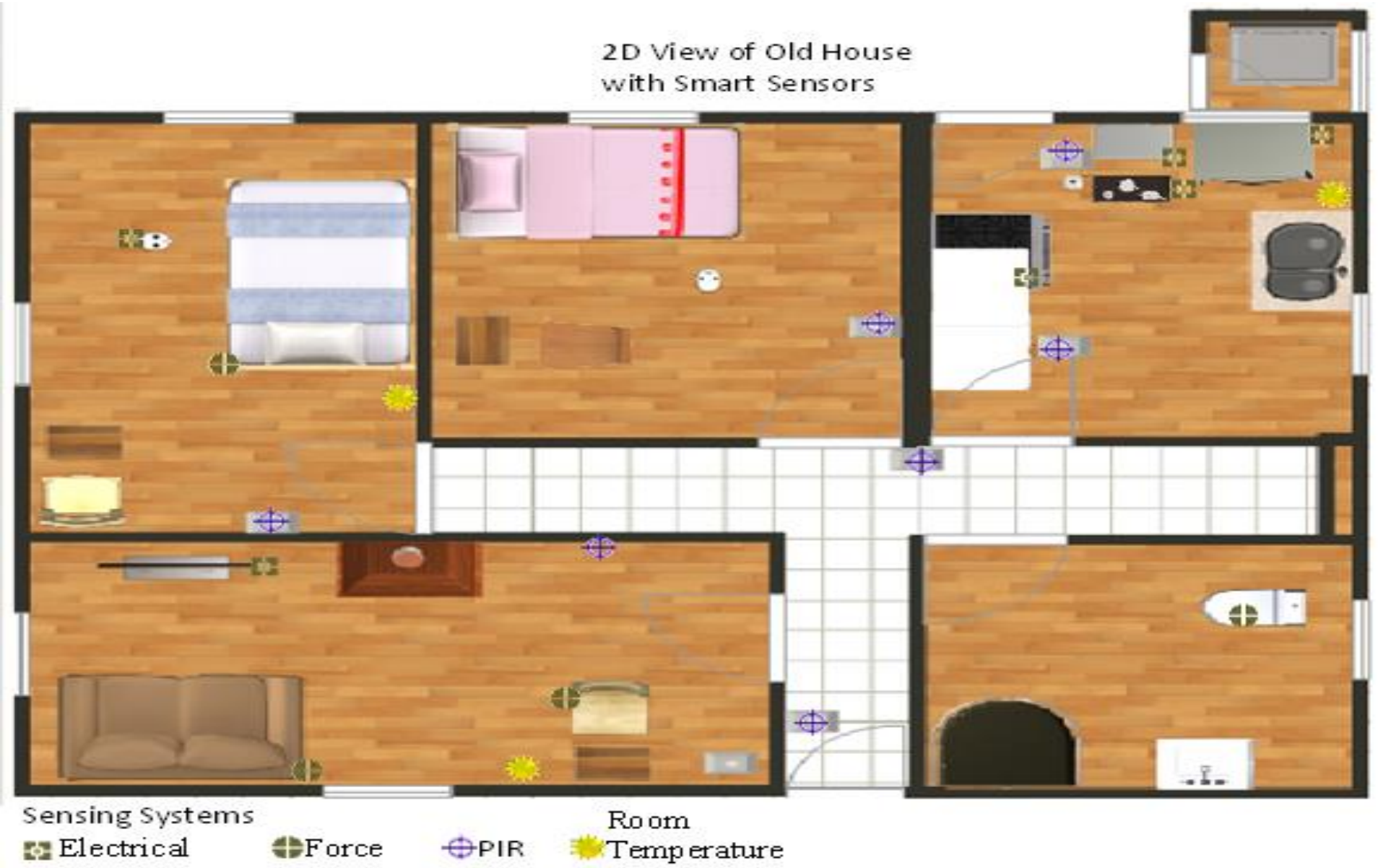
ADL	α	Household Appliance Usage
Preparation of Food (Breakfast,Lunch,Dinner)		Microwave, Water Kettle, Toaster or (any other item used regularly in Kitchen)
Sleeping		Room Heater
Toileting, Self Grooming		Television/Radio
Dinning		Bed, Couch, Chair, Toilet
Relax		Any other appliance used as habitual
Watching TV(while sitting on Couch)		



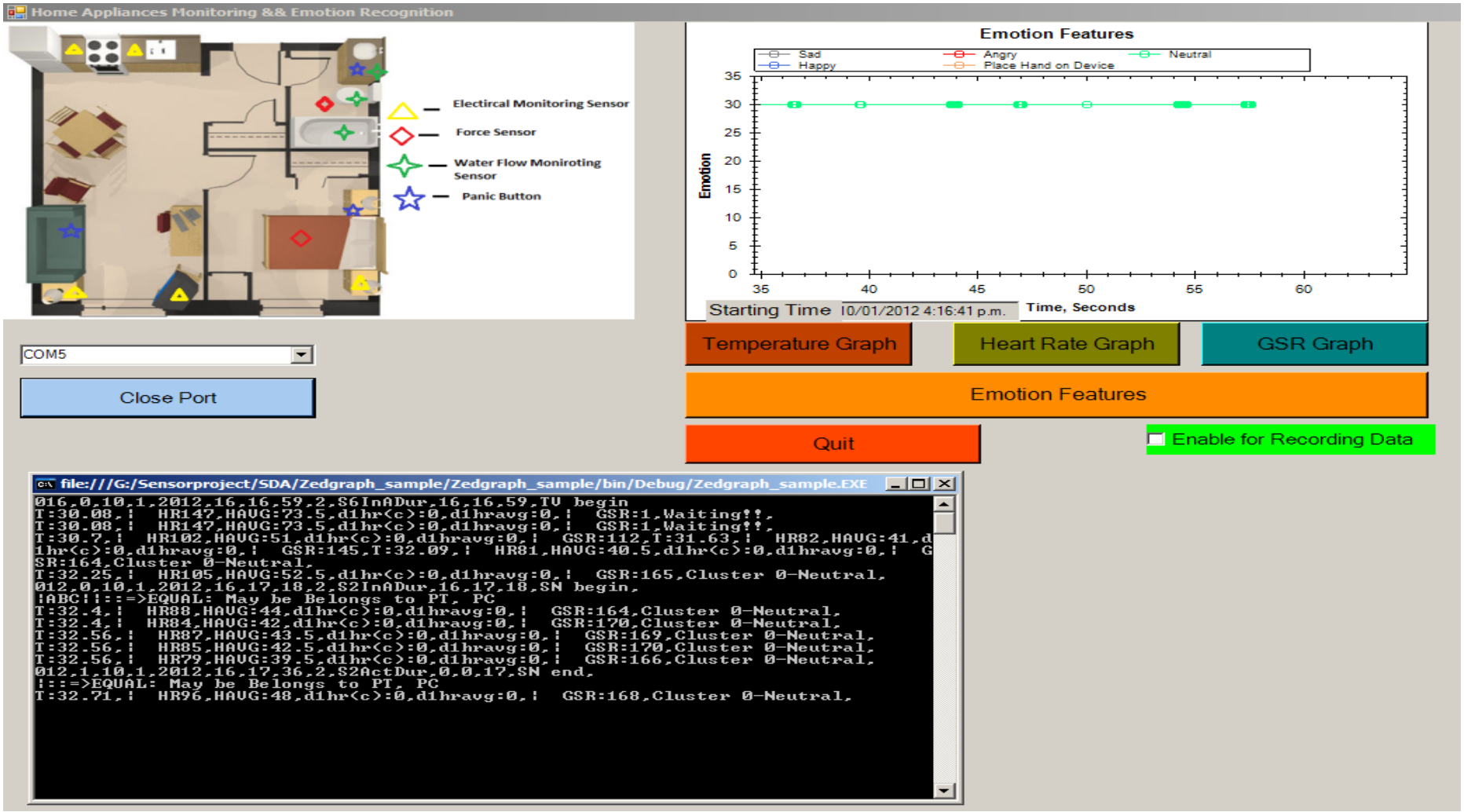
Passive Infra Red(PIR) Sensors: Mobility(Movements monitoring)

N.K.Suryadevara, S. C. Mukhopadhyay, R. Wang, R.K. Rayudu, "Forecasting the behavior of an elderly using wireless sensors data in a smart home", *Elsevier: Engineering Applications of Artificial Intelligence,* Available online 12 September 2013, ISSN 0952-1976, http://dx.doi.org/10.1016/j.engappai.2013.08.004.

Smart Sensor Deployment Layout



Human Emotion and ADL recognitions



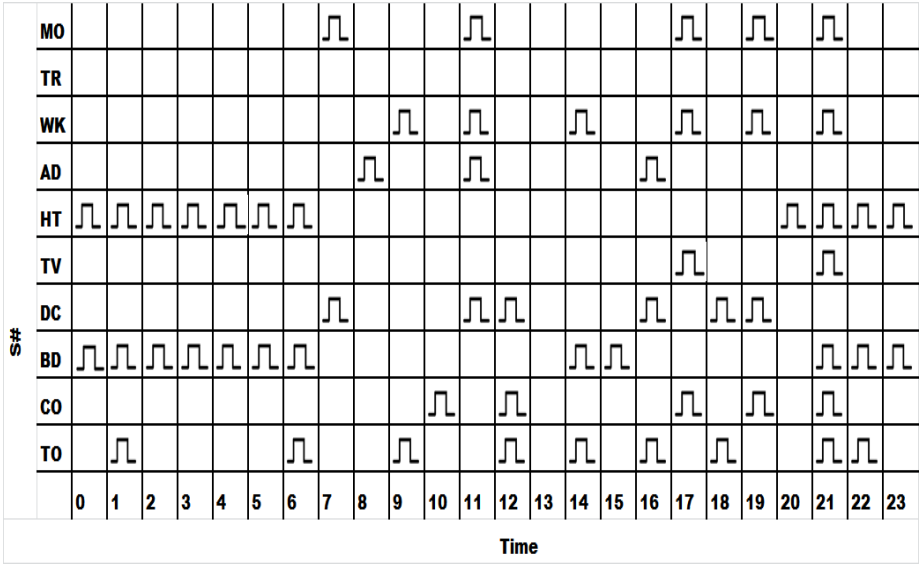
Quazi, M.T.; Mukhopadhyay, S.C.; **Suryadevara N.K.**; Huang, Y.M. "Towards the smart sensors based human emotion recognition", Proceedings of IEEE International Conference Instrumentation and Measurement Technology (I2MTC)-Austria-2012,Page(s):2365 – 2370, . ISBN: 9781457717710

Human Emotional State Recognition Unit

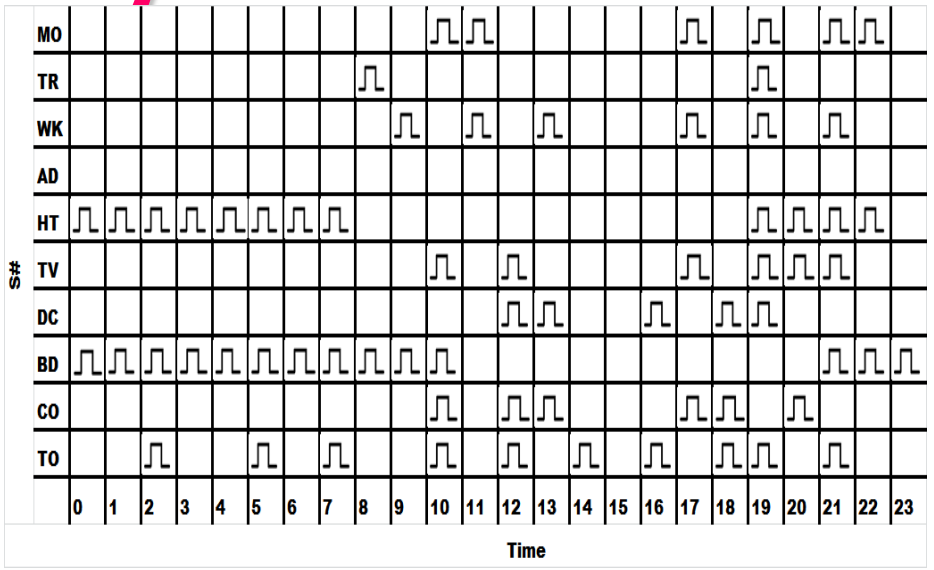


Quazi, M.T.; Mukhopadhyay, S.C.; **Suryadevara N.K**.; Huang, Y.M. "Towards the smart sensors based human emotion recognition", Proceedings of IEEE International Conference Instrumentation and Measurement Technology (I2MTC)-Austria-2012,Page(s):2365 – 2370, . ISBN: 9781457717710

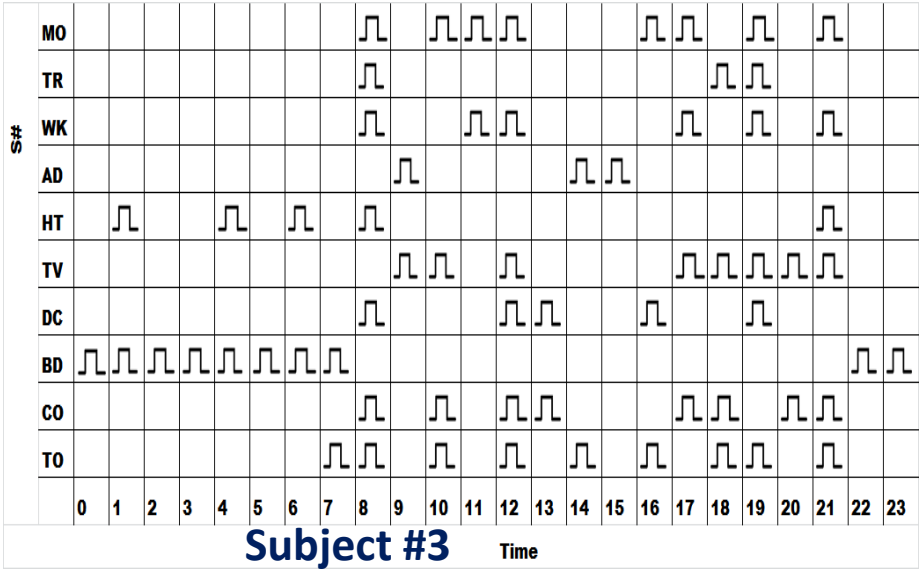
Sensor activity status



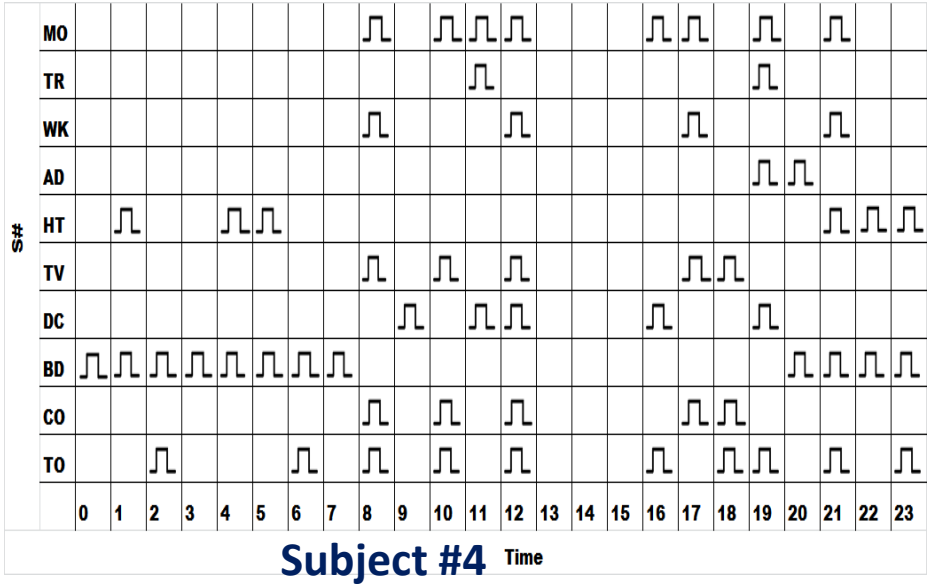
Subject #1



Subject #2



Subject #3



Subject #4

Suryadevara N.K, Mukhopadhyay S.C, "Wireless Sensor Network based Home Monitoring System for Wellness Determination of Elderly", IEEE Sensors Journal-2012, Vol: 12 Issue: 6, Page(s): 1965 – 1972

- **Domestic objects are used at regular time intervals in the day to day life**
- **Usage durations and the frequency of use are varied**
- ***"Human behaviours in constant contexts recur, because the processing that initiates and controls their performance becomes automatic"***
- ***"Frequency of past behaviour reflects the habit strength and has a direct effect on future performance"***

Wellness Determination

$$\beta_{(1,old)} = (1 - t / T)$$

$$\beta_{(2,old)} = 1 + (1 - t_a / T_n)$$

$$\beta_{1,new} = e^{-t/T}$$

$$\beta_{2,new} = e^{\frac{(T_n - T_a)}{T_n}}$$



ADL Recognition

Level-2



Context Recognition

Level-1

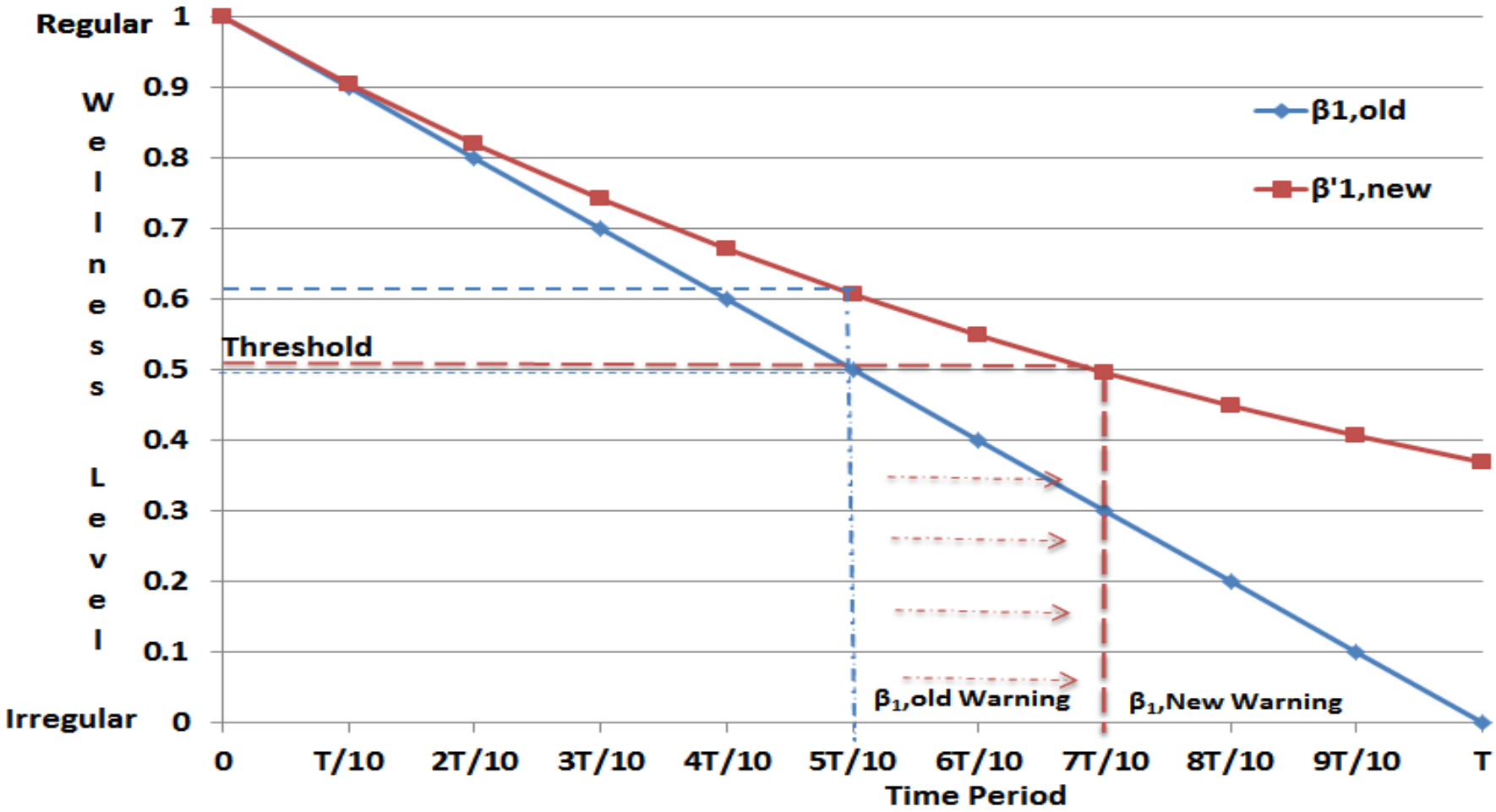


Sensor Event

Level-0

Improved Wellness Function ($\beta_{1,\,new}$)

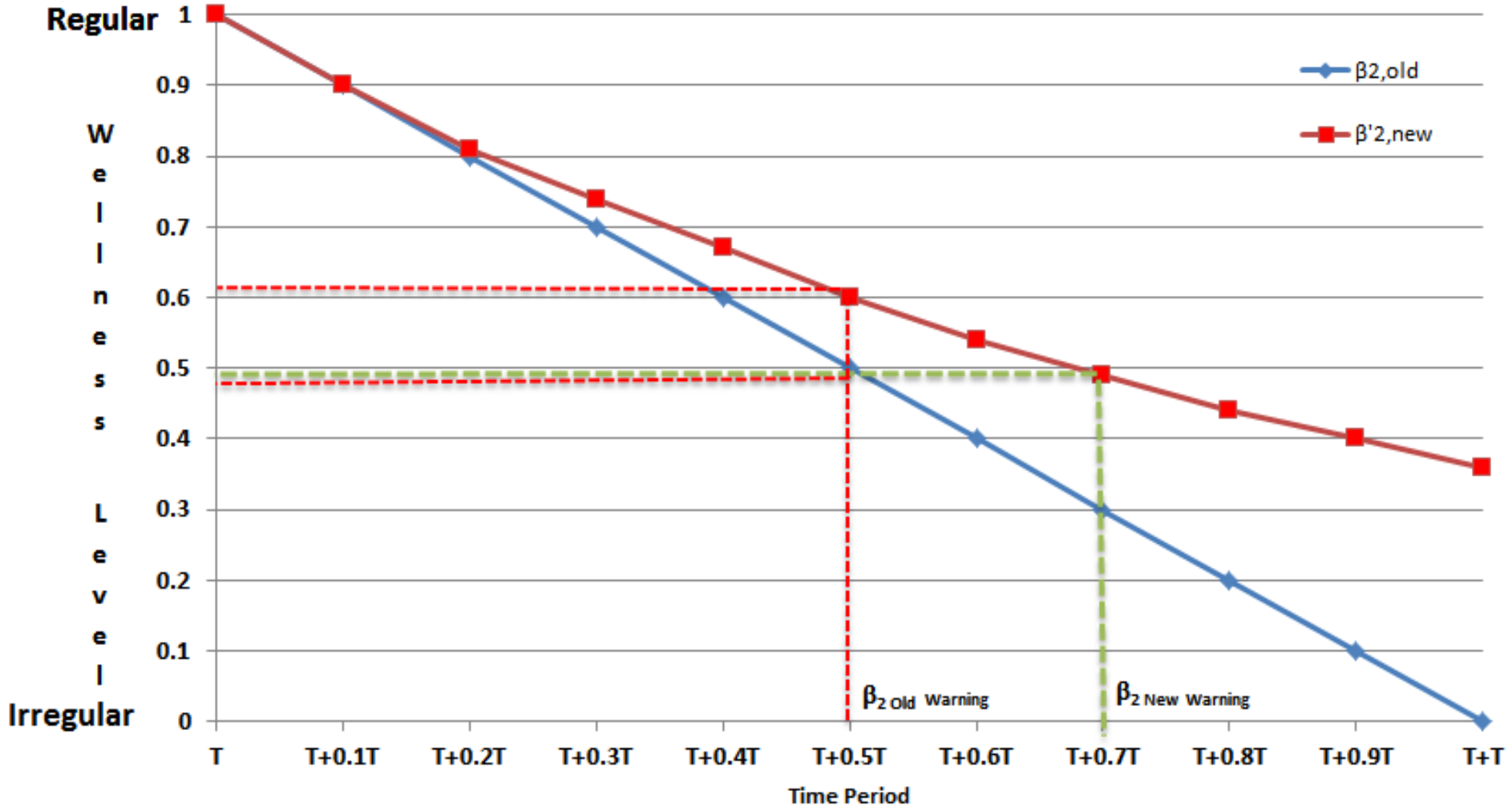
$$\beta_{1,new} = e^{-t/T}$$



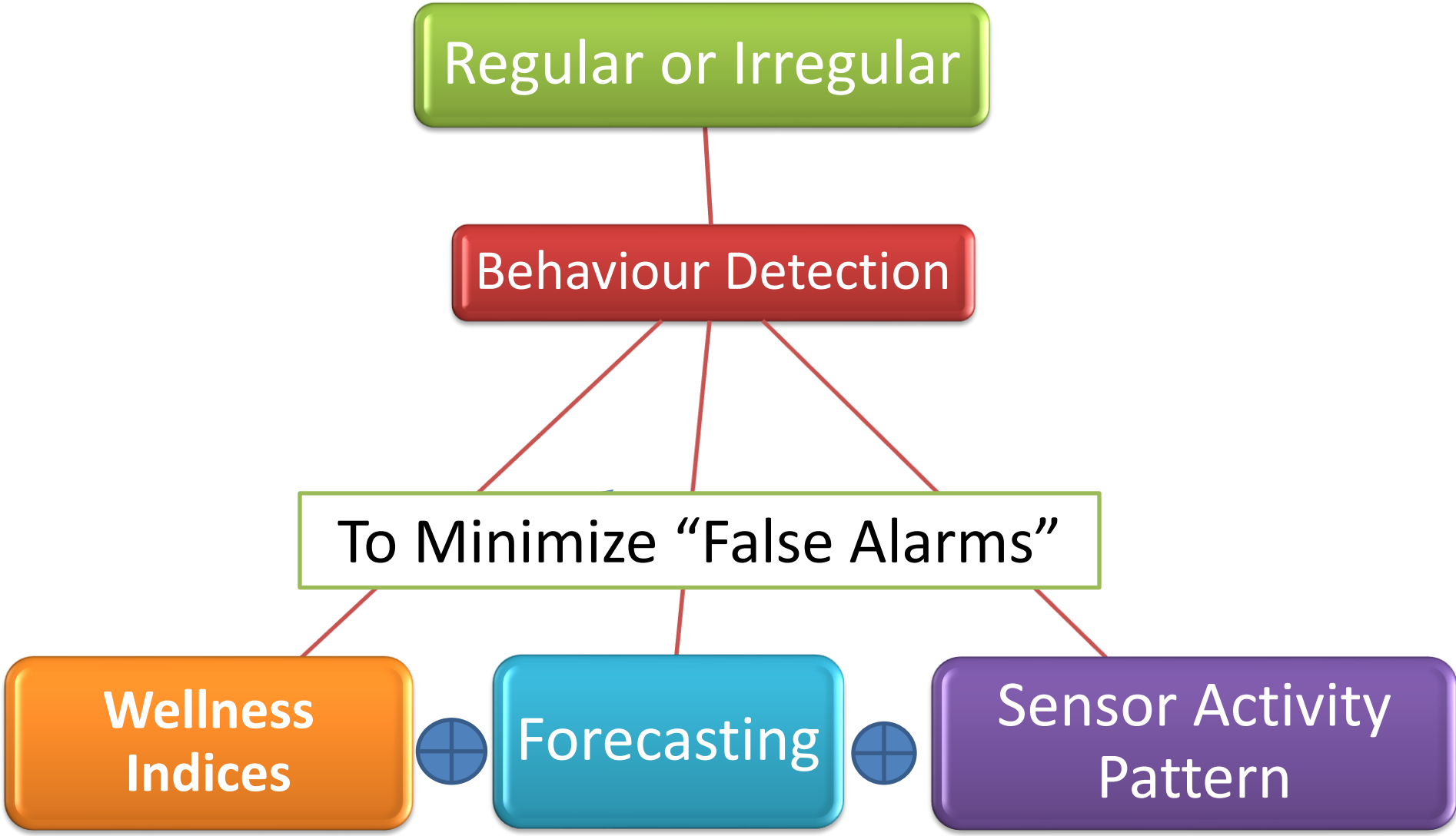
Suryadevara N.K, Mukhopadhyay S.C, "Determining Wellness through an Ambient Assisted Living Environment," **IEEE Intelligent Systems**-May 2014,Page(s):30-37, ISSN:1541-1672

Improved Wellness Function ($\beta_{2,\,new}$):

$$\beta_{2,new} = e^{\frac{(T_n - T_a)}{T_n}}$$

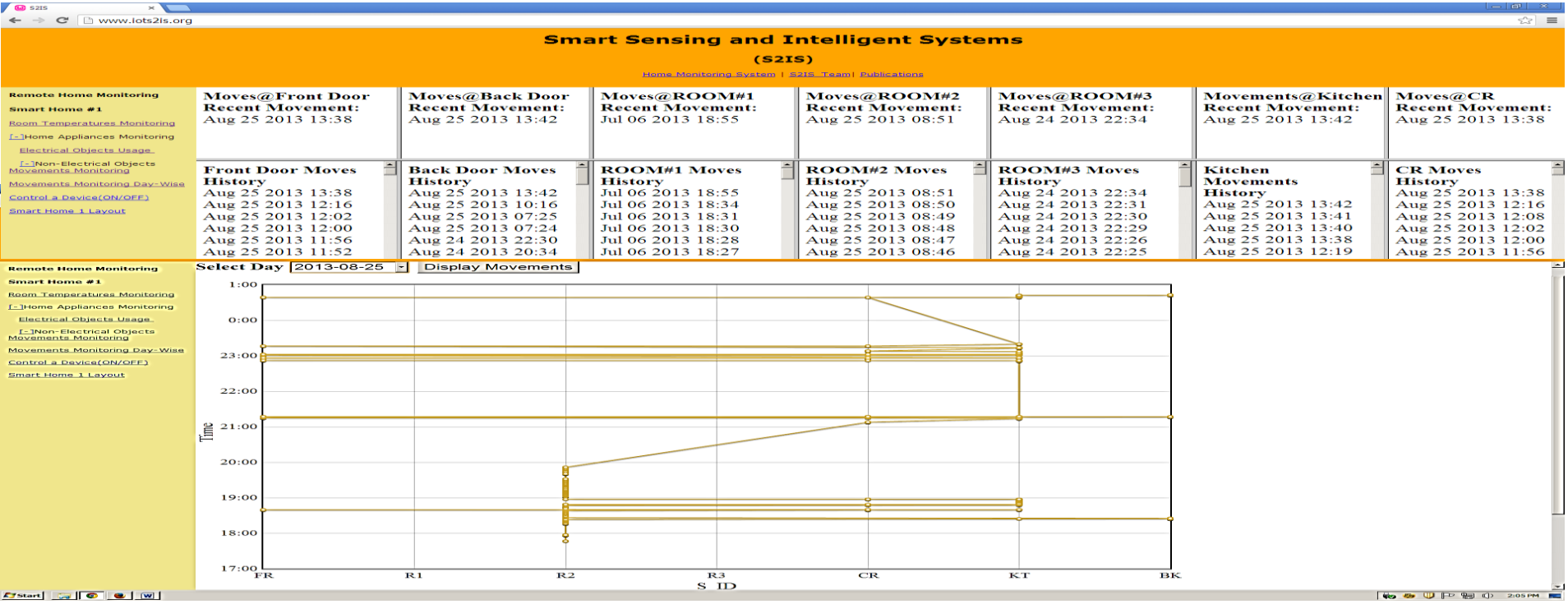


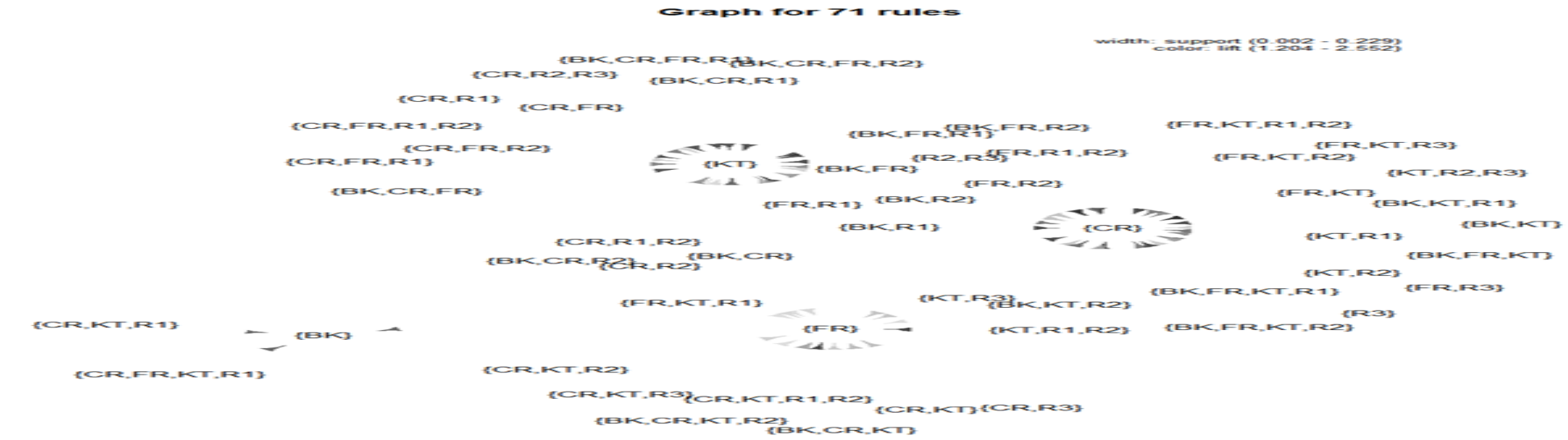
Suryadevara N.K, Mukhopadhyay S.C, "Determining Wellness through an Ambient Assisted Living Environment," **IEEE Intelligent Systems**-May 2014,Page(s):30-37, ISSN:1541-1672



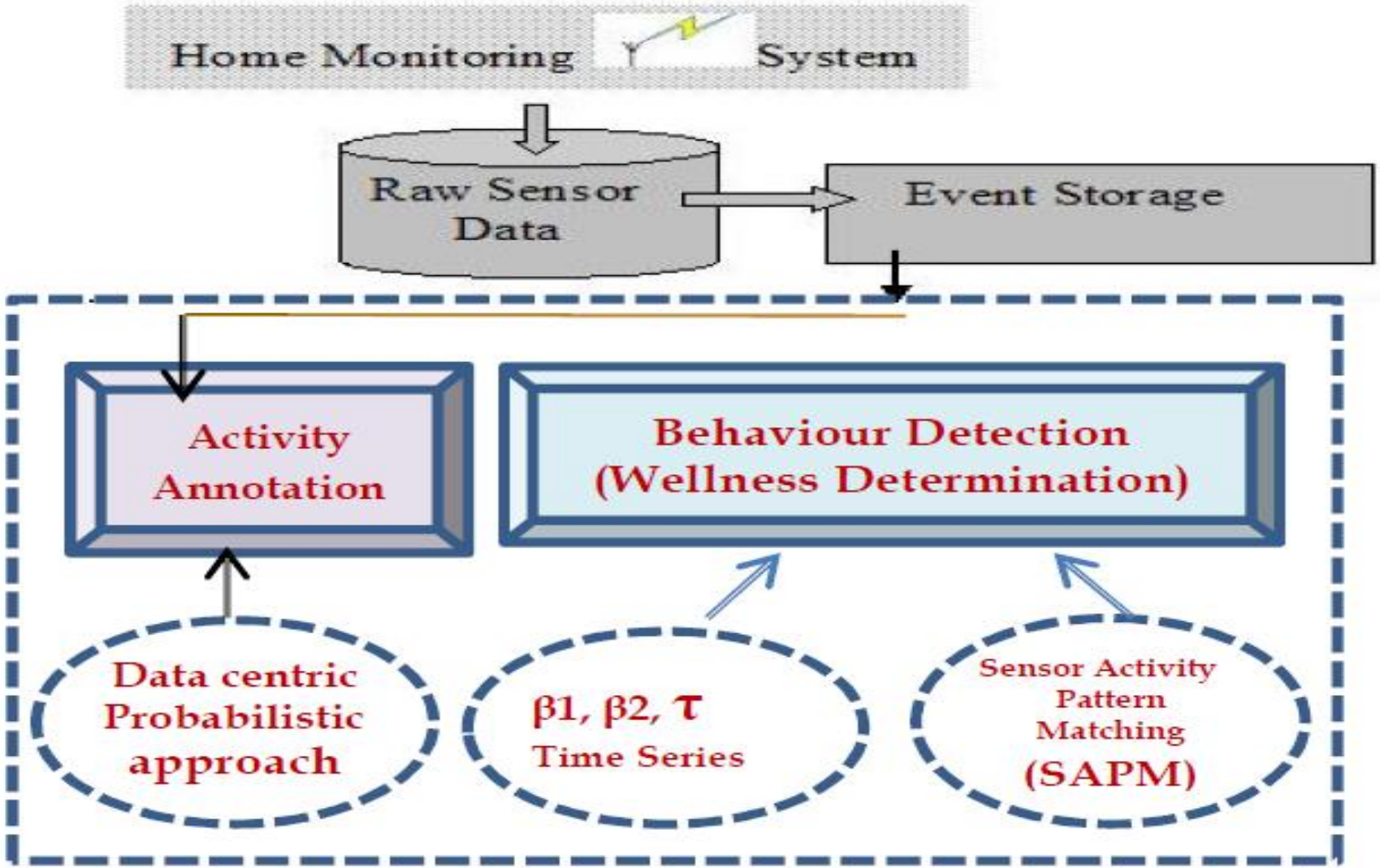
N.K.Suryadevara, S. C. Mukhopadhyay, R. Wang, R.K. Rayudu, Forecasting the behavior of an elderly using wireless sensors data in a smart home, *Elsevier: Engineering Applications of Artificial Intelligence,* Available online 12 September 2013, ISSN 0952-1976, http://dx.doi.org/10.1016/j.engappai.2013.08.004.

Tracking System





Wellness Determination



N.K.Suryadevara, S. C. Mukhopadhyay, R. Wang, R.K. Rayudu, Forecasting the behavior of an elderly using wireless sensors data in a smart home, *Elsevier: Engineering Applications of Artificial Intelligence,* Available online 12 September 2013, ISSN 0952-1976, http://dx.doi.org/10.1016/j.engappai.2013.08.004.

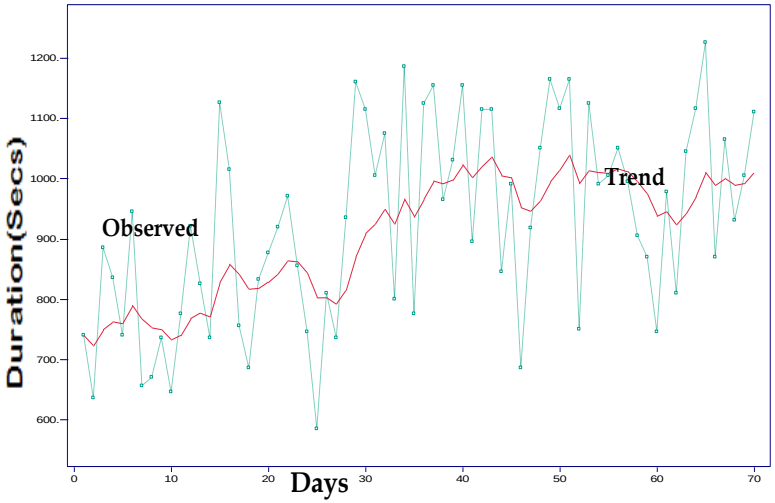


Fig 9(a) Toilet usage Trend for 70 days

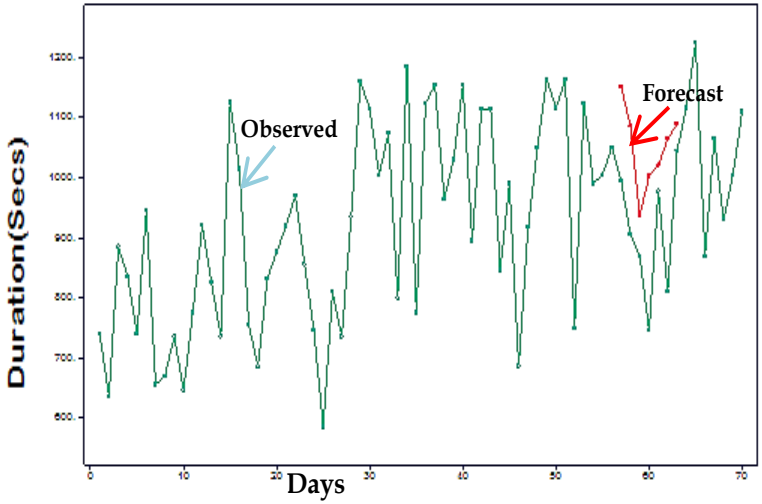


Fig 9(b) Toilet usage (Ninth week forecast pattern)

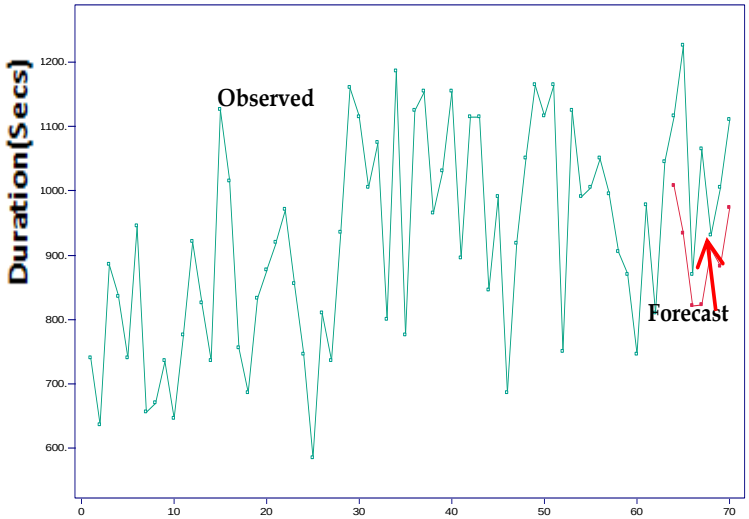


Fig 9 (c) Toilet usage (Tenth week forecast pattern)

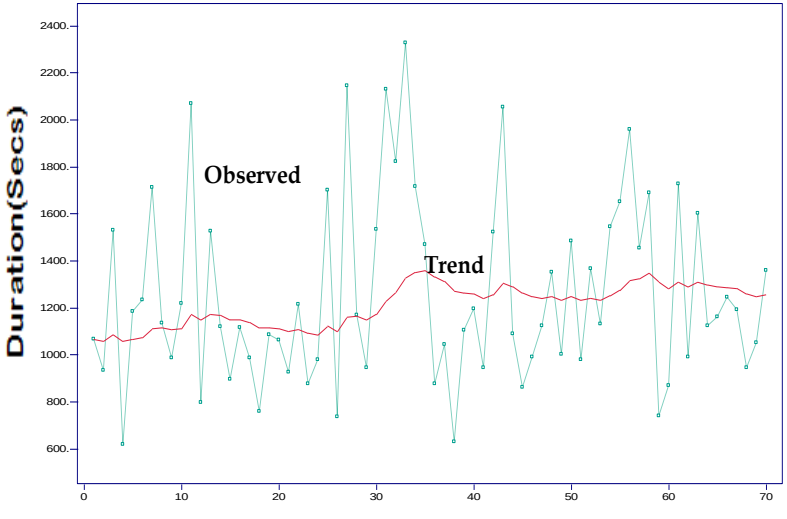
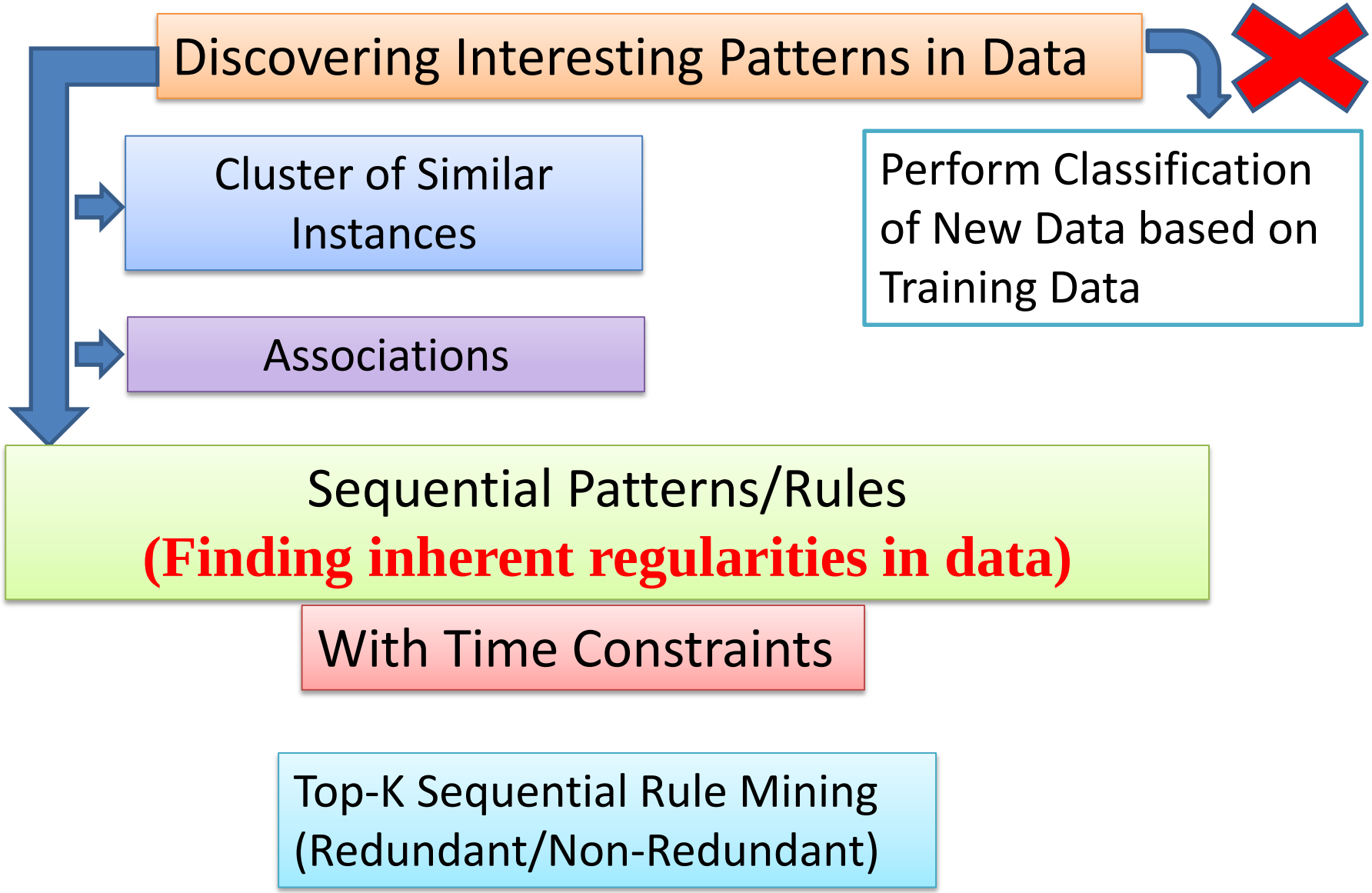


Fig 9(d) Chair Usage Trend for 70 days

N.K.Suryadevara, S. C. Mukhopadhyay, R. Wang, R.K. Rayudu, Forecasting the behavior of an elderly using wireless sensors data in a smart home, *Elsevier: Engineering Applications of Artificial Intelligence,* Available online 12 September 2013, ISSN 0952-1976, http://dx.doi.org/10.1016/j.engappai.2013.08.004.

Sensor Activity Pattern



Conclusion

WSN Assisted Intelligent Integrated Healthcare Platform for Wellbeing and Independent Living

The healthcare platform consists of

1. Appliances Monitoring Unit
2. Physiological parameters monitoring unit
3. Human Posture and Position Detection Unit
4. Human Emotion Recognition Unit
5. Automatic Medicine Dispenser Unit
6. Power Management Unit
7. Robust Supervisory Control Unit
8. Safety Box Unit

- **A WSN Assisted and Embedded Processing based smart home to care elderly people.**

- **The integrated system is able to support people who wish to live independently.**

- **The developed system is robust and is possible to develop at a low cost due to indigenous development.**

- **The technology assisted home will alert the caregiver in advance about the trend of the health status, so that necessary precaution can be taken.**

Thank you

suryadevara99@gmail.com