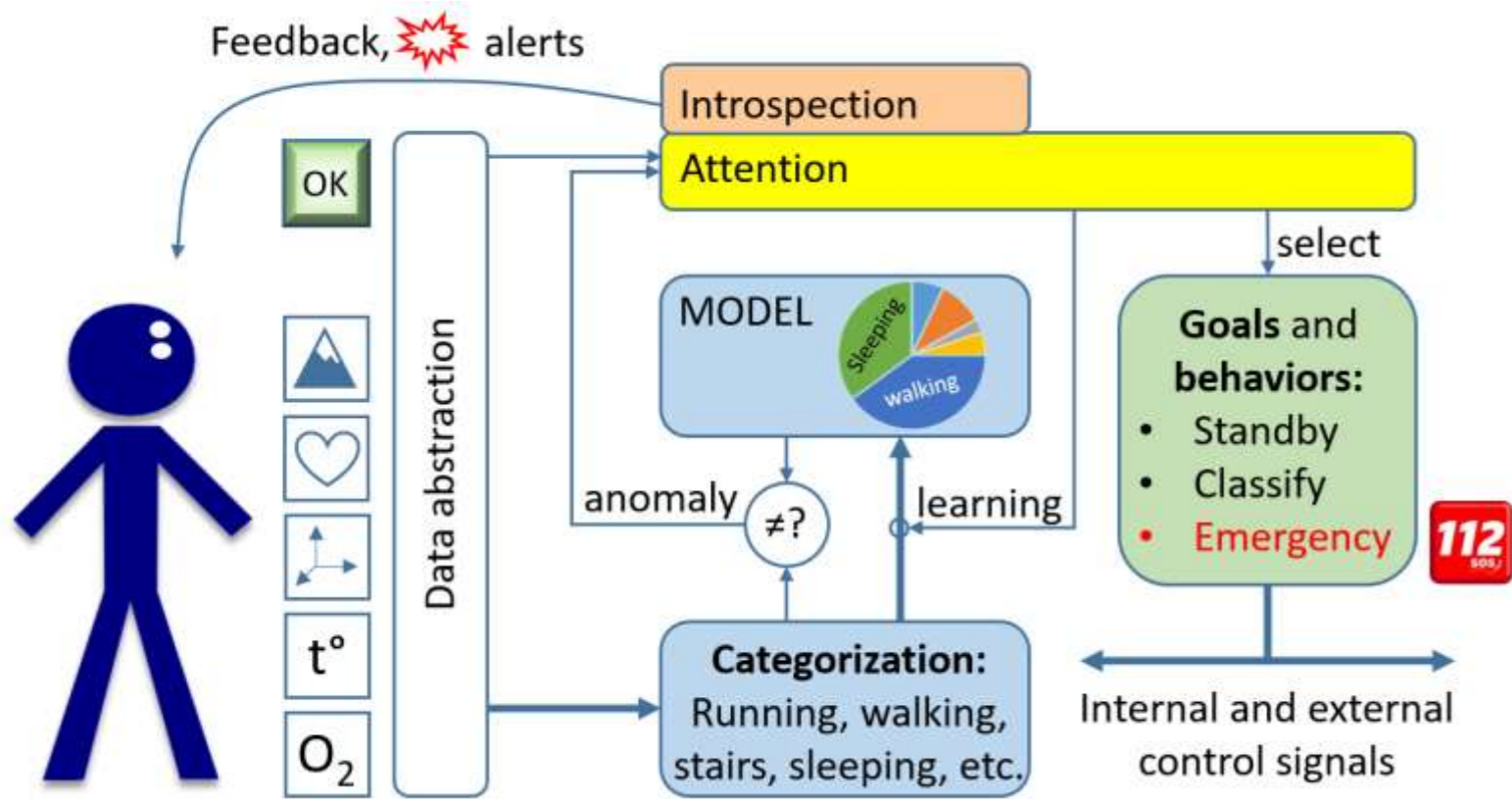


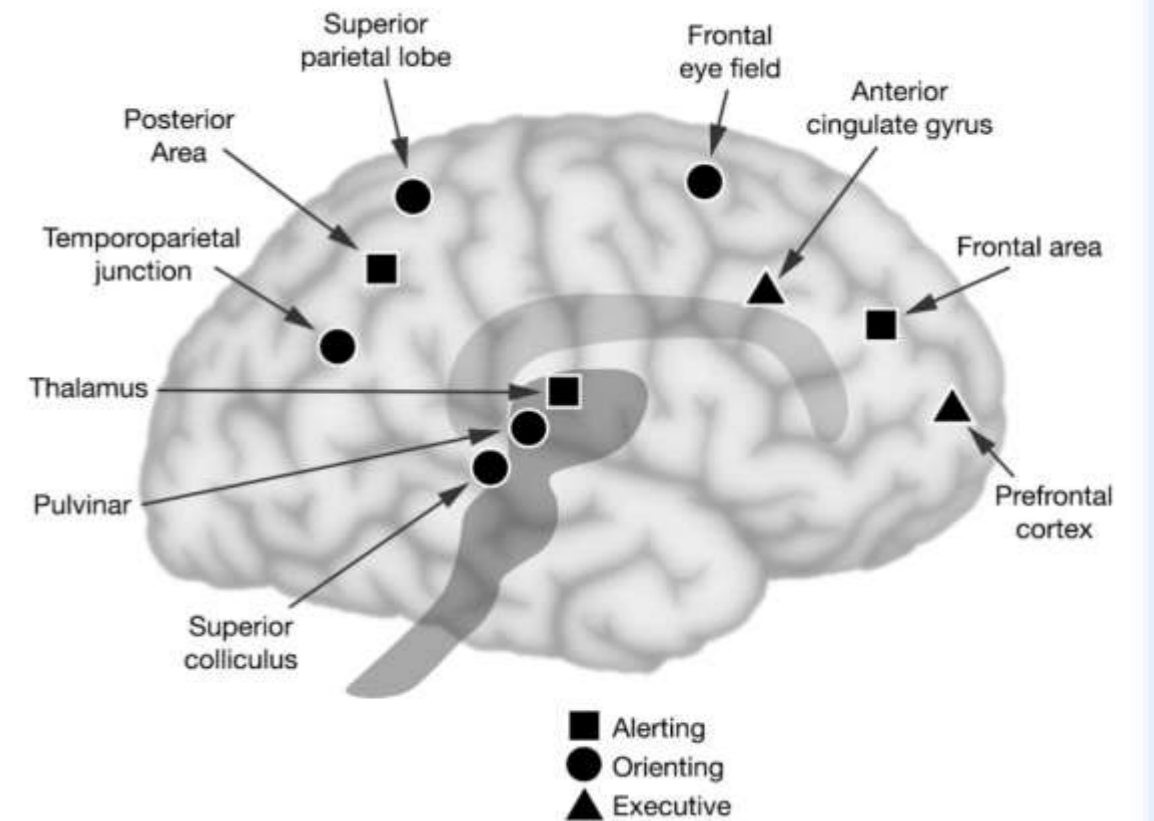
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**Abstract** - Recent research and theorizing suggest that goals guide behavior through attention, and this guidance can occur outside of person's awareness. [1]. Attention is a filter helping to selectively process only relevant information and thereby apply available energetic and bodily resources efficiently for survival or for aiming other goals. Contemporary technology enables devices to be informed over their environment and self (external and internal sensors), also control power consumption (low-power modes and techniques). The same could be extended to different hierarchical and/or flat networks (e.g. IoT) where attention signal will be propagated and interpreted between the devices and hierarchy levels, influencing node functions. In this paper inspired from biology attention network is proposed for the mist-fog-cloud type Cyber Physical Systems (CPSs) and benefits of added functionality are analyzed.

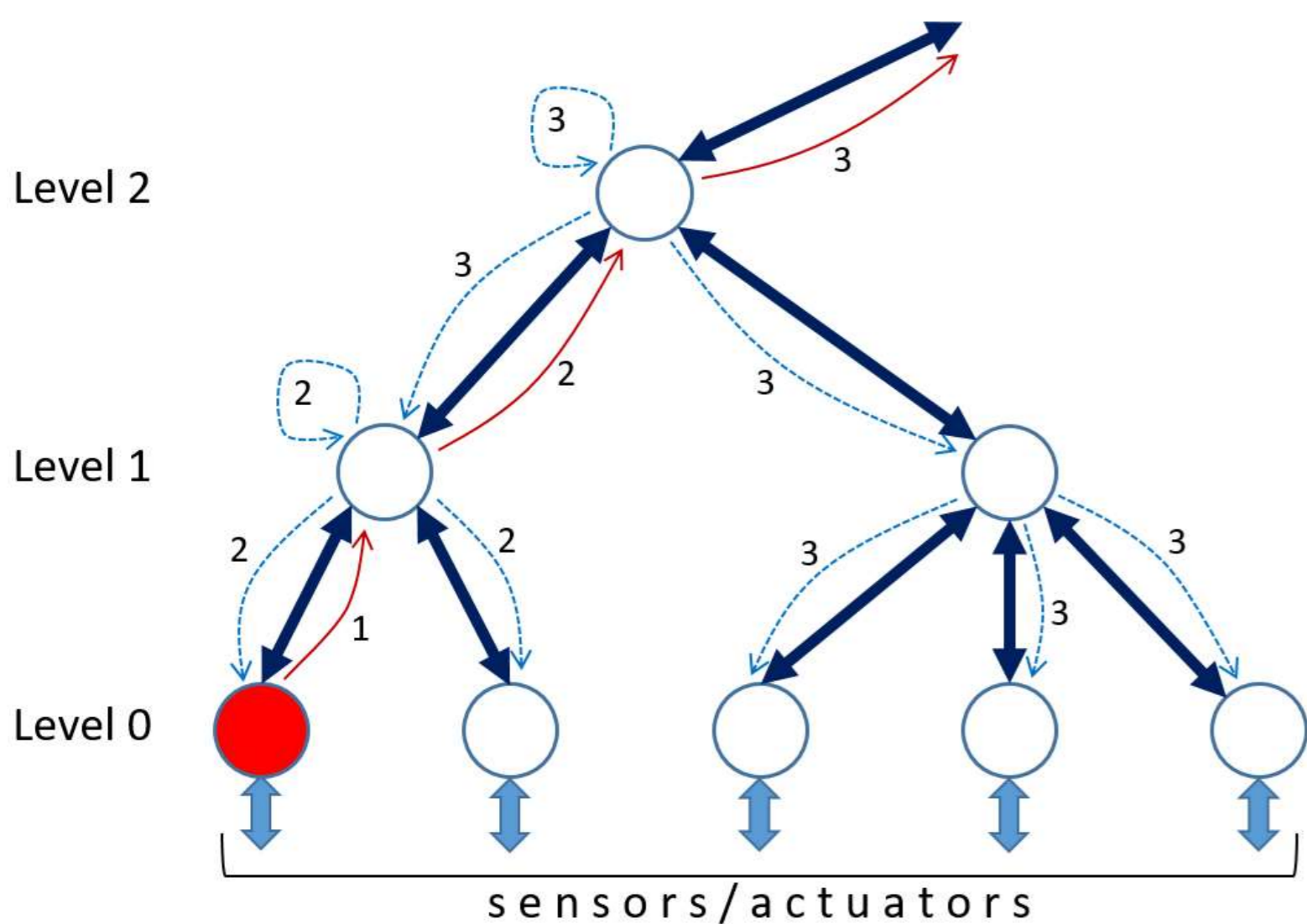


Architecture of self-aware health monitor [10]

Attention serves as a basic set of mechanisms that underlie our awareness of the world and the voluntary regulation of our thoughts and feelings. [8]



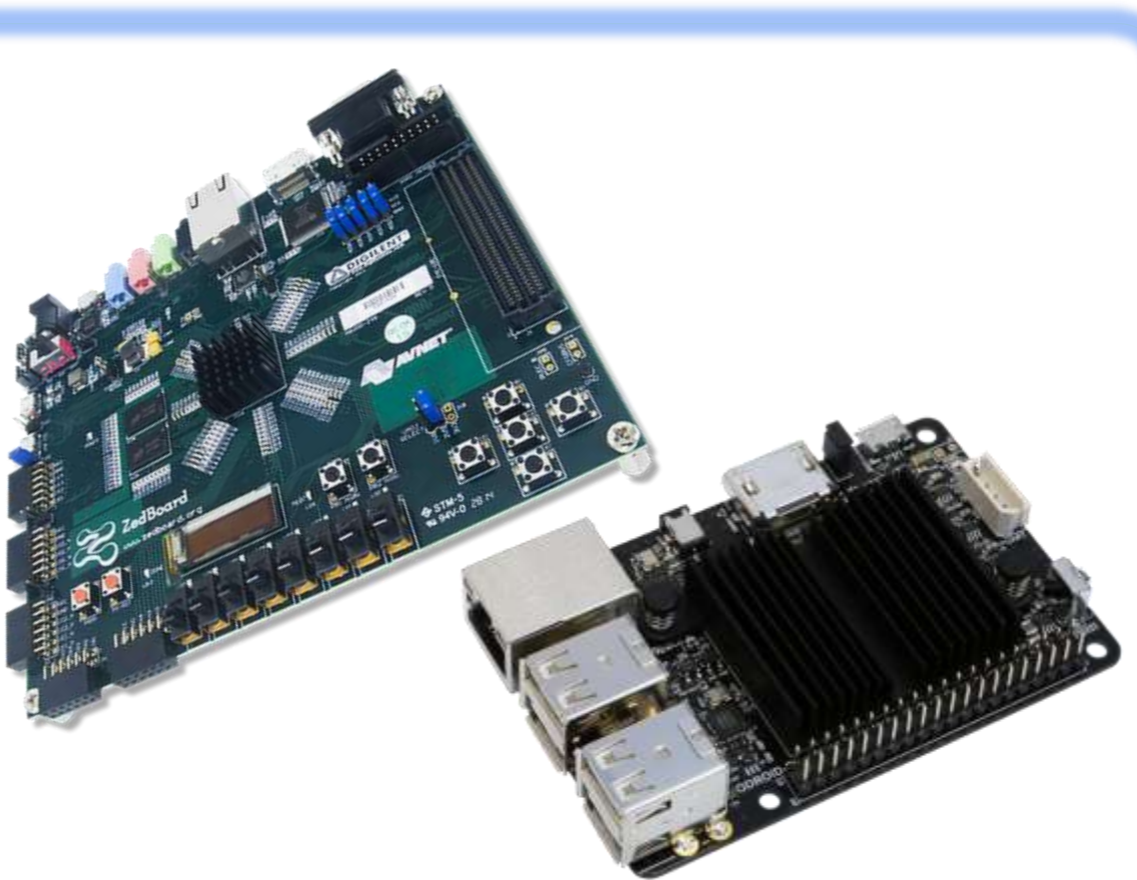
Anatomy of three attentional networks: **alerting, orienting, and executive attention.** Alerting is defined as achieving and maintaining a state of high sensitivity to incoming stimuli; orienting is the selection of information from sensory input; and executive attention involves mechanisms for monitoring and resolving conflict among thoughts, feelings, and responses. [8]



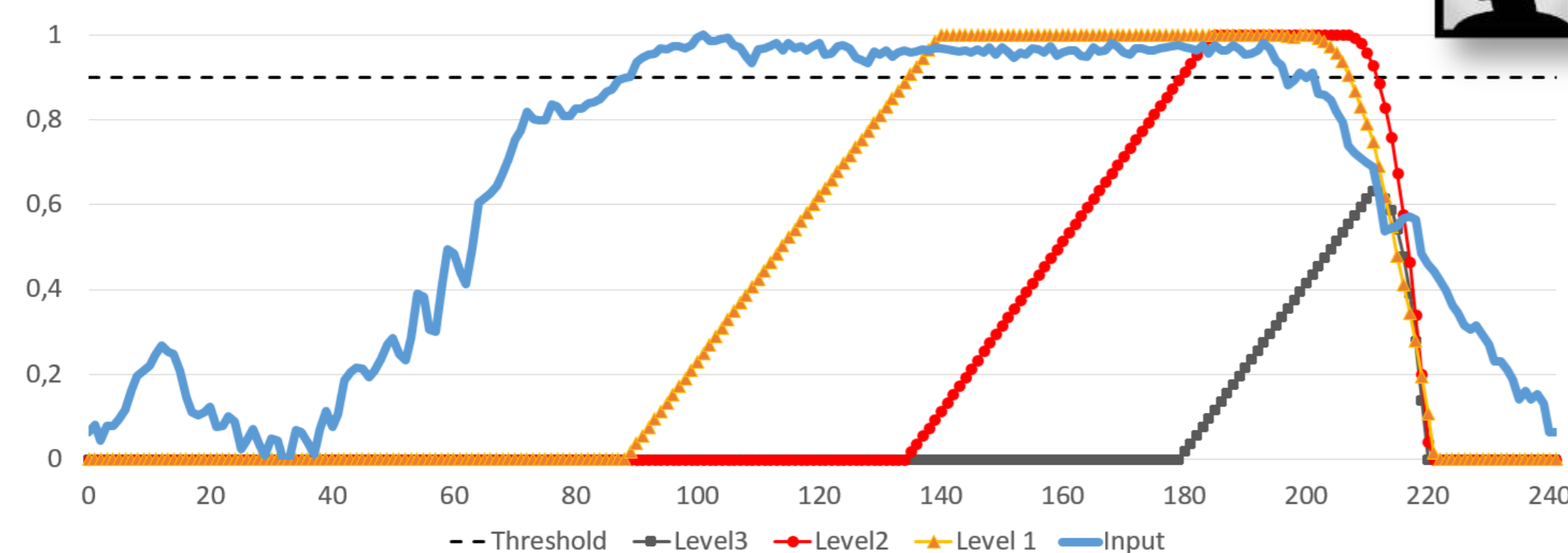
Attention broadcasting (Mist - Level 0, Fog - Level 1 and Cloud - Level 2). Solid red line – upward broadcasting of anomaly/alert signal, dashed blue line – broadcasting the attention across the level.

**Under development:** Fog level gateways (platforms) capable of Hierarchical Temporal Memory (HTM, Numenta Inc.) processing of fused input streams, continuous prediction and anomaly detection.

- ZedBoard Zynq-7000 (with XC7Z020 SoC FPGA) [12, Master thesis], and
- Odroid-C2 (single-board computer with 2GB of RAM) [Master thesis]



MistBot – Edge node	Current [mA]	Voltage [V]	Total power
2 x Omron MEMS D6T	10	5	0,05
PIR sensor	0,1	5	0,0005
Light sensor	0,33	3,3	0,00109
LCD screen	3,64E-06	3,3	1,20E-05
RGB LED (1/3 active)	6	5	0,03
CPU (20MHz)	15,7	5	0,0785
CPU (Hibernation)	0,45	5	0,00225
ESP8266 (full power)	170	3,3	0,561
ESP8266 (sleep)	0,5	3,3	0,00165

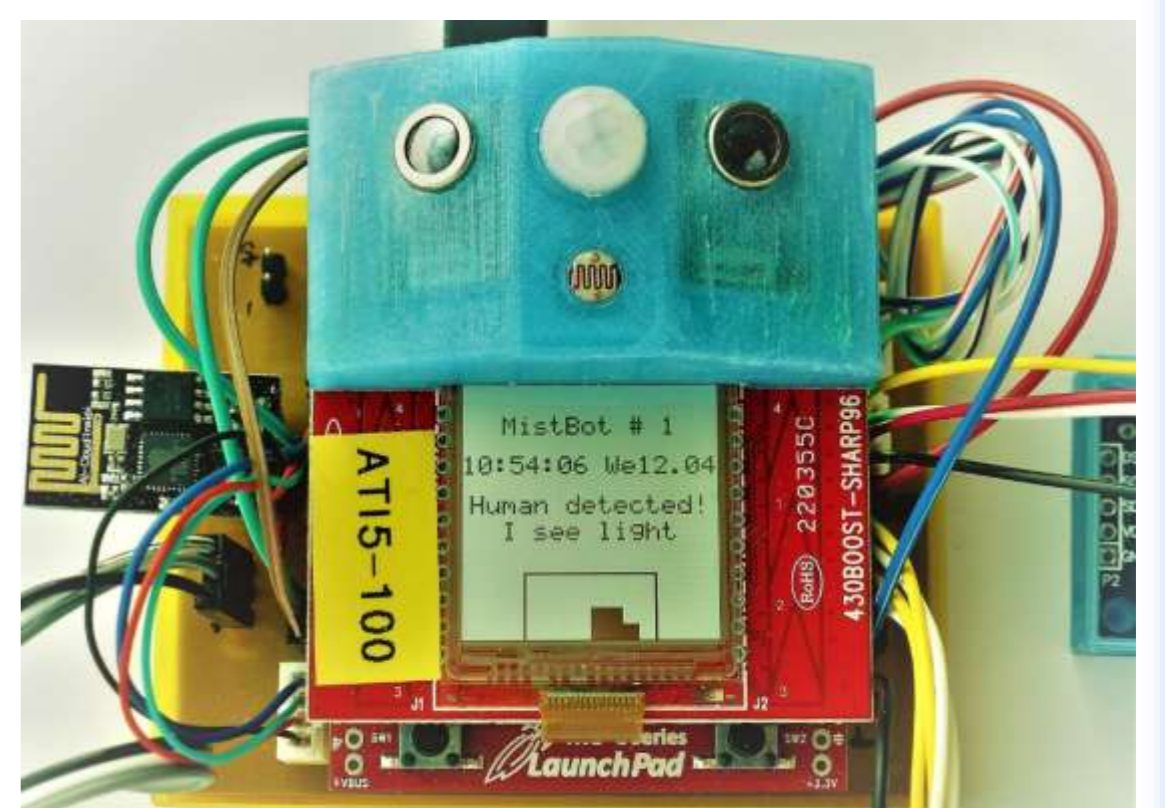
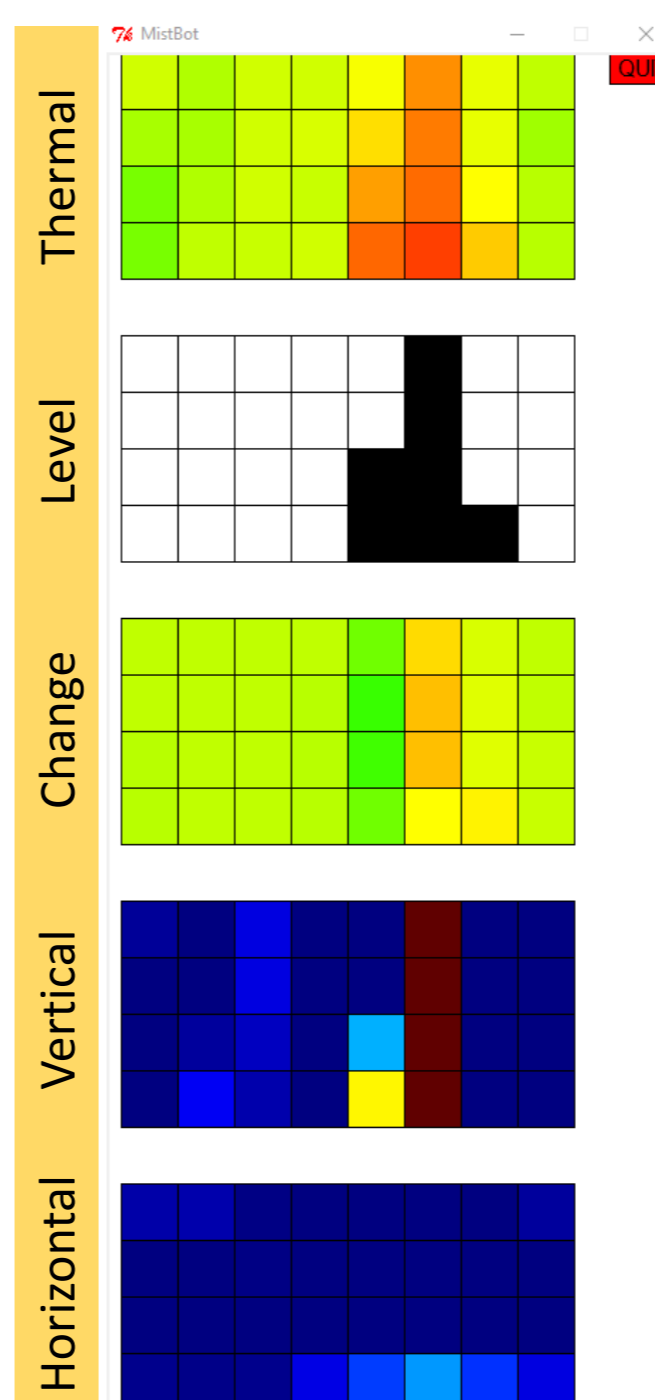


Alert attention broadcasting from edge node to higher levels. Low level anomaly signal exceeding the threshold is causing alertness arousal on next level of hierarchy etc.

**Research papers:**

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- [3] J. Driver, "A selective review of selective attention research from the past century," British Journal of Psychology, vol. 92, pp. 53–78, 2001.
- [4] H. P. Helgason, "General attention mechanism for artificial intelligence systems," Ph.D. dissertation, Reykjavik University, 7 2013.
- [5] C. H. Corbato, "Model-based self-awareness patterns for autonomy," Ph.D. dissertation, Technical University of Madrid, 2013.
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- [7] H. Admoni, B. Hayes, D. Feil-Seifer, D. Ullman, , and B. Scassellati, "Are You Looking At Me? Perception of Robot Attention is Mediated by Gaze Type and Group Size," in 8th ACM/IEEE International Conference on Human-Robot Interaction (HRI), 2013.
- [8] M. I. Posner and M. K. Rothbart, "Research on attention networks as a model for the integration of psychological science," Annual Review of Neuroscience, vol. 58, pp. 1–23, December 2007.
- [9] C. Montemayor and H. H. Haladjian, Consciousness, Attention, and Conscious Attention. The MIT Press, 2015.
- [10] J. S. Preden, K. Tammemäe, A. Jantsch, M. Leier, A. Riid, and E. Calis, "The benefits of self-awareness and attention in fog and mist computing," Computer, pp. 37–45, July 2015.
- [11] E. I. Knudsen, "Fundamental components of attention," Annual Review of Psychology, vol. 30, pp. 57–87, July 2007.
- [12] M. Kerner, K. Tammemäe, "Hierarchical Temporal Memory implementation on FPGA using LFSR based spatial pooler address space generator", DDECS 2017, Dresden

The thermal sensors (2 units) are registering non-intrusive thermal picture of the subject in sector 90° x 44,2°. The picture will be processed into horizontal and vertical dynamic components using edge detection algorithms. MistBot is expected to learn and predict very roughly major weekly activity patterns.



**MistBot - Edge node:**  
 Based on TI TM4C123GXL LaunchPad (ARM Cortex-M4 microcontroller).

**Inputs:**

- Two Omron MEMS Thermal sensors D6T-44L
- PIR sensor
- Photo resistor (light sensor)
- RTC (DS1307)
- Pushbuttons, microswitch joystick

**Outputs:**

- Serial interface
- WiFi ESP8266
- HCI: RGB LED (visual feedback)
- HCI: Mini speaker (audio alert and feedback)
- LCD module 430BOOST-SHARP96
- CMOS switches to control power of sensors

This work has been supported through the baseline project B38 "Hardware and Software Solutions for Cognitive Embedded Networks Systems" with Thomas Johann Seebeck Department of Electronics, Tallinn University of Technology.