Proactive Model for Handling Conflicts in Sensor Data Fusion Applied to Robotic Systems

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Problem statement

- Sensor fusion used in robotics systems and other IT systems to combine data coming from different sensors
- To reduce the uncertainty the information would have, existing solutions try to reduce the noise in the sensor, even the one that is caused by external factors
- Context of the system could be used to identify situations in which some sensors malfunction
- Using this knowledge, our system tries to circumvent failing or malfunctioning sensors and calculate estimates based on other sensors

Related Work

- IMU enabled GPS[1]
- Rule-based Proactive engine developed at the University of Luxembourg[2]
- Information fusion under conisderation of conflicting input signals[3]
- A Rule-Based Approach for Self-Optimisation in Autonomic EHealth Systems[4]

Contribution

- Model for fault detection and conflict handling in sensor fusion
- Context-based conflict detection and handling process using a rule engine
- Enhancement of final information and attribution of sensor confidence values to ease the decision making process of an external system

System Architecture

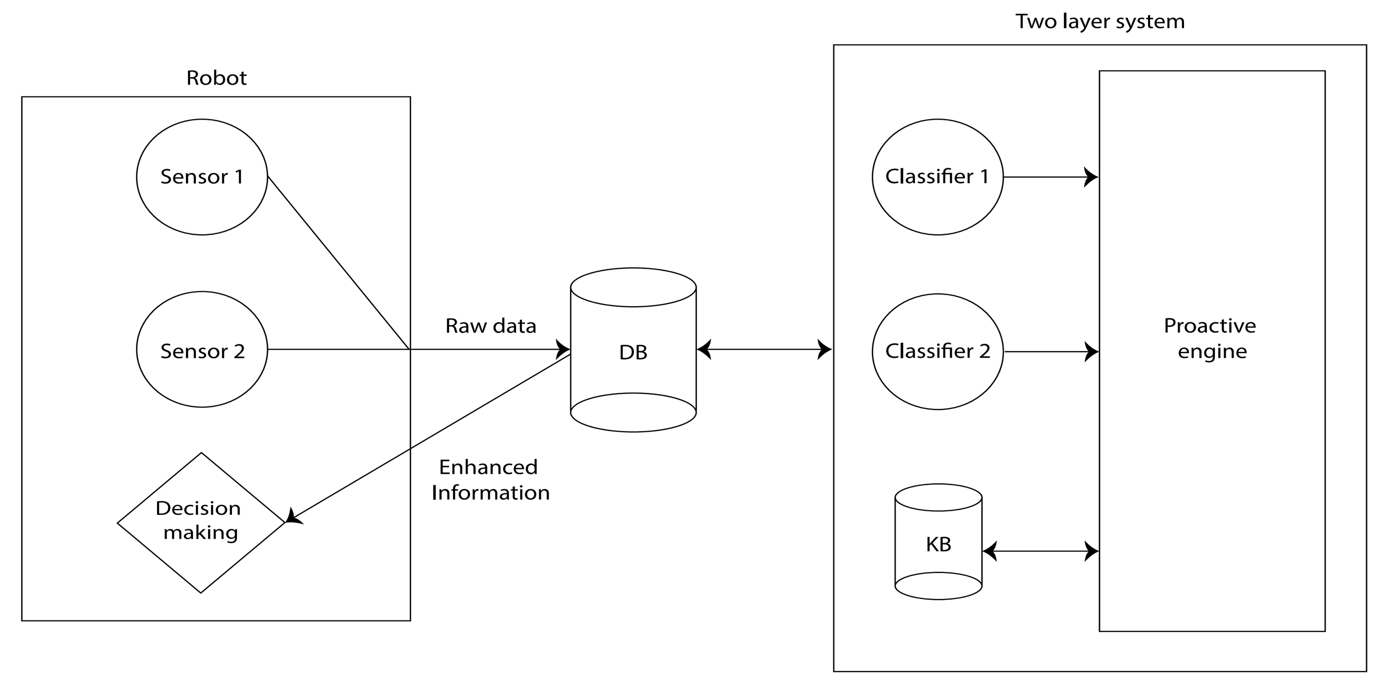

Figure 1: System architecture

- The data from sensors is passed to a two layer system
- On the first layer, classifiers attribute a confidence values to sensors. A low confidence means that the sensor is likely malfunctioning.
- The rule-based proactive engine uses these confidence values to first build the context for the current situation, and then it decides which sensors can be trusted and updates the confidence values.
- Finally, for malfunctioning sensors, the system attempts to take data from similar values or tries to calculate estimates and sends them back to the robot where the robot can then use the enhanced information to make decisions.

Possible Classifier: Convolutional neural network

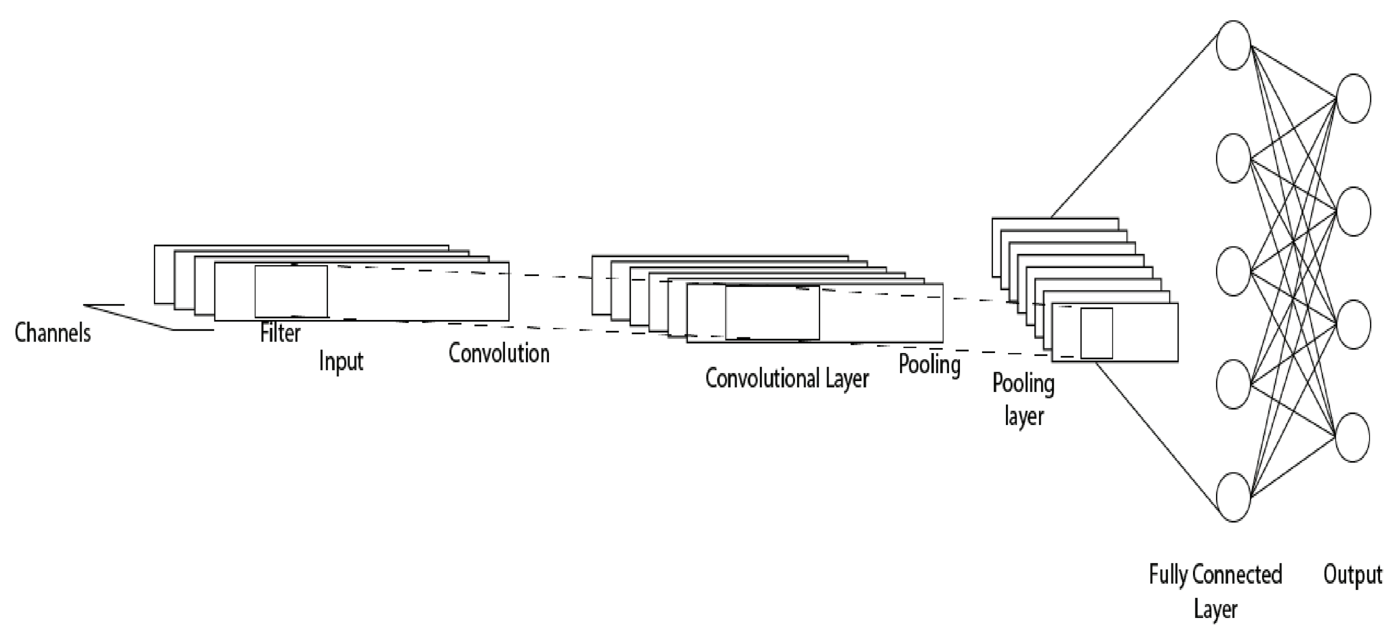

Figure 2: Convolutional neural network architecture

Scenario flow

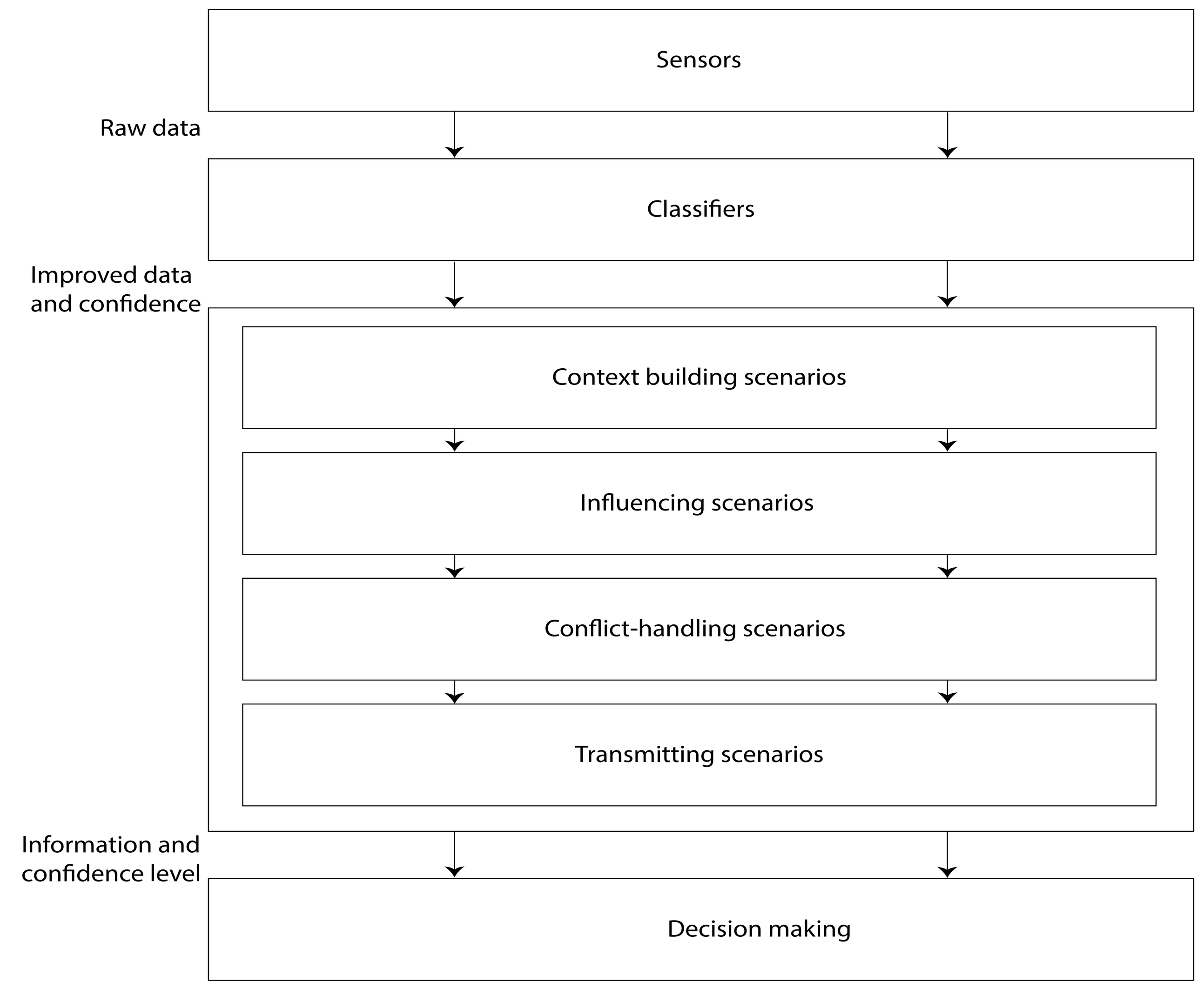

Figure 3: Scenario flow

References

[1] Bommi, R.M., Monika, V., Narmadha, R., Bhuvaneswari, K. and Aswini, L., 2019. IMU-Based Indoor Navigation System for GPS-Restricted Areas. In International Conference on Computer Networks and Communication Technologies (pp. 157-166). Springer, Singapore.

[2] D. Zampunieris, "Implementation of efficient proactive computing using lazy evaluation in a learning management system (extended version)," International Journal of Web-Based Learning and Teaching Technologies, vol. 3, pp. 103–109, 2008.

[3] Mönks, U., 2017. Information Fusion Under Consideration of Conflicting Input Signals. Heidelberg: Springer Berlin Heidelberg.

[4] Neyens, G.I.F. and Zampunieris, D., 2018, April. A Rule-Based Approach for Self-Optimisation in Autonomic EHealth Systems. In ARCS Workshop 2018; 31th International Conference on Architecture of Computing Systems (pp. 1-4). VDE.

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