Canovaccio for the pilot scenario "escort at night"

Objectives

1. Analyse the limitations of single-sensing modality approaches
2. Verify whether multi-modal sensing allows for a more accurate/faster context assessment and consequent robot response
3. [NEW!] Implement an integrated information gathering system on the robot, which asks the person to compensate for missing sensory information → context assessment is managed by a planning/reasoning system which, in case the information required to define the context is not given by the sensory system, actively retrieves it by asking the person.
4. [NEW!] Verify whether the integrated information gathering system converges to the correct situation faster than the multi-modal sensing system, or, equivalently, whether it converges to a more accurate assessment of the situation.
5. [NEW!] Implement a hybrid knowledge representation system, which is based on ontologies for the definition of the domain and on constraint reasoning for the analysis of the context evolution → instead of a single domain, the reasoner has a set of small sub-domains to operate on. The ontological system defines at all times which is the sub-domain of relevance.
6. [NEW!] Verify whether the hybrid knowledge representation system is computationally more efficient than the classical reasoning system with a single domain.

Resources

DORO robot (Ängen), Double robot (EMAROlab)

Localization sensors with room-wide precision

Posture/fall detection sensor

Gesture sensor

Open/close sensor for kitchen drawer and fridge

Plot outline

CASE 1: Bathroom

Case 1.1: assistance in walking (Ängen)

The person is asleep in the bedroom. The robot is in its charging station in the livingroom. The person wakes up to go to the bathroom and asks for the robot's assistance. The robot reaches the person and accompanies the person to the bathroom and later on back to the bedroom. The person goes back to sleep and the robot goes back to its charging station.

Case 1.2: intentional emergency call (EMAROlab)

The person is asleep in the bedroom. The robot is in its charging station in the livingroom. The person wakes up to go to the bathroom. It's not the first time that the person gets up this night. The monitoring system asks whether everything is all right. The person says that she has stomach ache and that she would like to call her daughter. The robot reaches the person and starts the skype call.

CASE 2: Kitchen

Case 2.1: no assistance (Ängen, EMAROlab)

The person is asleep in the bedroom. The robot is in its charging station in the livingroom. The person wakes up, goes to the kitchen and gets a glass of water. Then, then person goes back to sleep.

Case 2.2: monitoring system inquiry (Ängen, EMAROlab)

The person is asleep in the bedroom. The robot is in its charging station in the livingroom. The person wakes up, goes to the kitchen and gets a glass of water. It's not the first time that the person gets up to drink this night. The monitoring system asks whether everything is all right. The person says that everything is fine. The person goes back to sleep.

CASE 3: Fall

Case 3.1: light fall (Ängen)

The person is asleep in the bedroom. The robot is in its charging station in the livingroom. The person wakes up to go to the kitchen and drink a glass of water. While walking, the person falls down. On the basis of the sensors readings and the person's responses, the monitoring system determines that the person is ok, but in need of assistance to walk back to the bedroom. The robot reaches the person in the kitchen and assist her in walking back to the bedroom. The person goes back to sleep and the robot goes back to its charging station.

Case 3.2: hard fall (EMAROlab)

The person is asleep in the bedroom. The robot is in its charging station in the livingroom. The person wakes up to go to the kitchen and drink a glass of water. While walking, the person falls down. On the basis of the sensors readings and the person's responses, the monitoring system determines that the person is in need of assistance. The robot reaches the person in the kitchen and starts a skype call to the emergency contact.

Tests outline

1. Test cases 1,2,3 with only environmental sensors
2. Test cases 1,2,3 with only wearable sensors
3. Test cases 1,2,3 with the full sensory setup

Detailed plots

Case 1.1: assistance in walking (Ängen)

[The person is asleep in the bedroom. The robot is in its charging station in the livingroom.]

The person wakes up and moves to a sitting position on the bed. PIR sensors signal that there is movement in the bedroom. Wearable sensors signal that the person is in a sitting posture.

Monitoring system (via the smartphone): <Hi! Do you want the robot's assistance?>

Person:<Yes.>

The robot moves to the bedroom.

Robot: <Hi! Is everything all right?>

Person: <Yes. I just need to go to the bathroom.>

Robot: <Can I help you to walk to the bathroom?>

Person: <Yes, thanks!>

The robot turns around, to allow for an easier grasp of the handle by the person.

The person grabs the handle and stands up.

The robot guides the person to the bathroom. The person walks behind it. PIR sensors signal that there is movement in the bedroom, then in the area between the bedroom door and the bathroom door. Wearable sensors signal that the person is in a standing posture and walking.

The person opens the door of the bathroom, enters and closes it again. The robot turns around and waits outside.

[…]

The person opens the door of the bathroom and grabs the handle.

The robot guides the person to the bedroom. The person walks behind it. PIR sensors signal that there is movement in the area between the bathroom door and the bedroom door, then in the bedroom. Wearable sensors signal that the person is in a standing posture and walking.

The person releases the handle and lies down on the bed. Wearable sensors signal that the person is in a lying posture.

Robot: <Is there anything else I can do?>

Person: <No, thank you.>

The robot goes back to its charging station.

Case 1.2: intentional emergency call (EMAROlab)

[The person is asleep in the bedroom. The robot is in its charging station in the livingroom.]

The person wakes up and moves to a sitting position on the bed. PIR sensors signal that there is movement in the bedroom. Wearable sensors signal that the person is in a sitting posture. It's not the first time that the person gets up this night.

Monitoring system (via the smartphone): <Hi! It seems you're having a rough night. Do you want the robot's assistance?>

Person: <Yes, I want to call my daughter.>

The robot moves to the bedroom.

Robot: <Hi! Is everything all right?>

Person: <No, I have stomach ache.>

Robot: <Shall I call your emergency contact?>

Person: <Yes, thanks!>

The robot moves to face the person and starts a skype call.

Case 2.1: no assistance (Ängen, EMAROlab)

[The person is asleep in the bedroom. The robot is in its charging station in the livingroom.]

The person wakes up and moves to a sitting position on the bed. PIR sensors signal that there is movement in the bedroom. Wearable sensors signal that the person is in a sitting posture.

Monitoring system (via the smartphone): <Hi! Do you need the robot's assistance?>

Person:<No.>

The person stands up from the bed and walks into the kitchen. PIR sensors signal that there is movement in the bedroom, then in the area between the bedroom door and the kitchen door, then in the kitchen. Wearable sensors signal that the person is in a standing posture and walking.

The person opens the drawer containing glasses and picks one glass. The drawer status sensor signals that it has been opened and closed again.

The person reaches the sink and fills the glass with tap water. Then, the person drinks (taking any number of gulps). Wearable sensors signal that the person is in a standing posture and drinking.

The person puts the glass in the sink and walks back in the bedroom. PIR sensors signal that there is movement in the kitchen, then in the area between the kitchen door and the bedroom door, then in the bedroom. Wearable sensors signal that the person is in a standing posture and walking.

The person lies down on the bed. Wearable sensors signal that the person is in a lying posture.

Case 2.2: monitoring system inquiry (Ängen, EMAROlab)

[The person is asleep in the bedroom. The robot is in its charging station in the livingroom.]

The person wakes up and moves to a sitting position on the bed. PIR sensors signal that there is movement in the bedroom. Wearable sensors signal that the person is in a sitting posture.

Monitoring system (via the smartphone): <Hi! Do you need the robot's assistance?>

Person:<No.>

The person stands up from the bed and walks into the kitchen. PIR sensors signal that there is movement in the bedroom, then in the area between the bedroom door and the kitchen door, then in the kitchen. Wearable sensors signal that the person is in a standing posture and walking.

The person opens the drawer containing glasses and picks one glass. The drawer status sensor signals that it has been opened and closed again.

The person reaches the sink and fills the glass with tap water. Then, the person drinks (taking any number of gulps). Wearable sensors signal that the person is in a standing posture and drinking.

The person puts the glass in the sink and walks back in the bedroom. PIR sensors signal that there is movement in the kitchen, then in the area between the kitchen door and the bedroom door, then in the bedroom. Wearable sensors signal that the person is in a standing posture and walking.

The person lies down on the bed. Wearable sensors signal that the person is in a lying posture.

[Later on…]

The person wakes up and moves to a sitting position on the bed. PIR sensors signal that there is movement in the bedroom. Wearable sensors signal that the person is in a sitting posture.

Monitoring system (via the smartphone): <Hi! Do you need the robot's assistance?>

Person:<No.>

The person stands up from the bed and walks into the kitchen. PIR sensors signal that there is movement in the bedroom, then in the area between the bedroom door and the kitchen door, then in the kitchen. Wearable sensors signal that the person is in a standing posture and walking.

The person opens the drawer containing glasses and picks one glass. The drawer status sensor signals that it has been opened and closed again.

The person reaches the sink and fills the glass with tap water. Then, the person drinks (taking any number of gulps). Wearable sensors signal that the person is in a standing posture and drinking.

Monitoring system (via the smartphone): <Hi! It seems that you are quite thirsty tonight. Is everything all right?>

Person:<Yes. Just, maybe eating a Mexican kebabpizza for dinner was not such a good idea…>

The person puts the glass in the sink and walks back in the bedroom. PIR sensors signal that there is movement in the kitchen, then in the area between the kitchen door and the bedroom door, then in the bedroom. Wearable sensors signal that the person is in a standing posture and walking.

The person lies down on the bed. Wearable sensors signal that the person is in a lying posture.

Case 3.1: light fall (Ängen)

[The person is asleep in the bedroom. The robot is in its charging station in the livingroom.]

The person wakes up and moves to a sitting position on the bed. PIR sensors signal that there is movement in the bedroom. Wearable sensors signal that the person is in a sitting posture.

Monitoring system (via the smartphone): <Hi! Do you need the robot's assistance?>

Person:<No.>

The person stands up from the bed and walks towards the kitchen. PIR sensors signal that there is movement in the bedroom, then in the area between the bedroom door and the kitchen door. Wearable sensors signal that the person is in a standing posture and walking.

Near the kitchen door, the person falls down. Wearable sensors signal that the person has fallen.

Monitoring system (via the smartphone): <I detected a fall! Was it a false alarm?>

The person moves to a sitting position. Wearable sensors signal that the person is in a sitting posture and moving.

Person:<No, I fell for real…>

Monitoring system (via the smartphone): <Do you want to alert your emergency contact?>

Person:<No, I'm fine. I just need help to stand up. Can you call the robot?>

The robot moves to the place where the person is.

Robot:<Hi! Can I help you to stand up?>

Person:<Yes, thank you.>

The person uses the robot to stand up. Wearable sensors signal that the person is in a standing posture.

Robot: <Is there anything else I can do?>

Person:<Yes, can you help me walk to the bedroom?>

Robot:<Of course.>

The robot guides the person to the bedroom. The person walks behind it. PIR sensors signal that there is movement in the area between the kitchen door and the bedroom door, then in the bedroom. Wearable sensors signal that the person is in a standing posture and walking.

The person releases the handle and lies down on the bed. Wearable sensors signal that the person is in a lying posture.

Robot: <Is there anything else I can do?>

Person: <No, thank you.>

The robot goes back to its charging station.

Case 3.2: hard fall (EMAROlab)

[The person is asleep in the bedroom. The robot is in its charging station in the livingroom.]

The person wakes up and moves to a sitting position on the bed. PIR sensors signal that there is movement in the bedroom. Wearable sensors signal that the person is in a sitting posture.

Monitoring system (via the smartphone): <Hi! Do you need the robot's assistance?>

Person:<No.>

The person stands up from the bed and walks towards the kitchen. PIR sensors signal that there is movement in the bedroom, then in the area between the bedroom door and the kitchen door. Wearable sensors signal that the person is in a standing posture and walking.

Near the kitchen door, the person falls down. Wearable sensors signal that the person has fallen.

Monitoring system (via the smartphone): <I detected a fall! Was it a false alarm?>

The person is lying on the floor and not moving. Wearable sensors signal that the person is in a lying posture and not moving.

The robot moves to the place where the person is.

Monitoring system (via the smartphone): <The robot will now call your emergency contact. Can you speak?>

Person:<Yes. I think I broke my right leg…>

The robot moves to face the person and starts a skype call.