The Thirteenth International Conference on Advances in Computer-Human Interactions (ACHI 2020)
November 21, 2020 to November 25, 2020 - Valencia, Spain

Smartphone Devices in Smart Environments: Ambient Assisted Living Approach for Elderly People

Roua Jabla, Maha Khemaja, Félix Buendía and Sami Faiz

Roua Jabla

University of Sousse, ISITCom, 4011 Hammam Sousse, Tunisia

Universitat Politècnica de Valencia, 46022 Valencia, Spain

jabla.roua@gmail.com

Short Resume

ROUA JABLA

2016

Higher institute of applied sciences and technology (ISSATSO)

- National Degree of Engineer in Applied Sciences and Technology specializing in Software Engineering.
- Graduated with honors.

2017 to Present

University of Sousse and Polytechnic university of Valencia (UPV)

- PhD student in Computer Sciences under a cooperation agreement.

Research Interests

- Ontology enabled knowledge management,
- Context-aware systems,
- Pervasive computing,
- Smart environments,

Outline

Introduction

Related work

Proposed approach

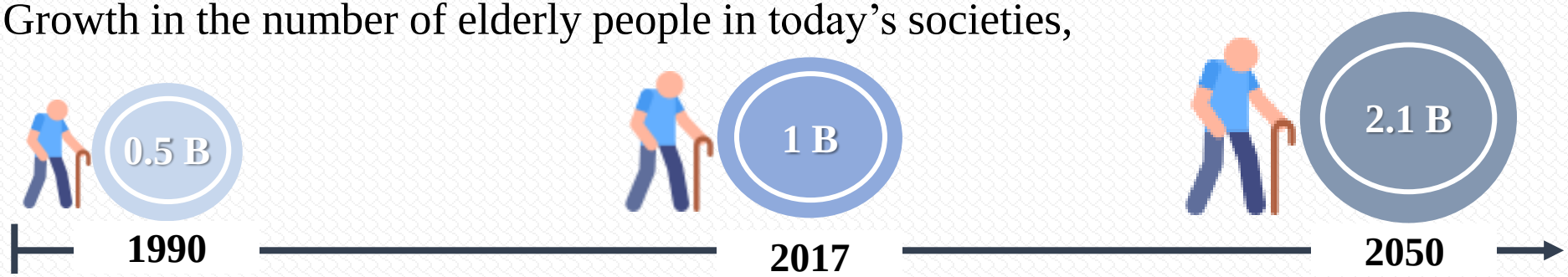
Case study

Result

Conclusions

Introduction

- **Aging population**
  - Growth in the number of elderly people in today's societies,



  - Development of multiple chronic diseases,
  - Increase in age-related declines,
  - Impairment of elderly's ability to remember and perform everyday activities,
- **Independent living**
- **Unmet needs of elderly people**

Introduction

- **Ambient Assisted Living (AAL) approach for elders**
  - Continuously monitoring and assisting elderly in different daily life situations and locations,
  - Meeting the unmet elderly needs,
  - Dynamically promoting services for assisting elderly at given context to continue living an independent life.
- **Context of the current work**
  - Mobile smart environment for supporting aging people life,
  - Demands:
    - ✓ Merging data provided by different sensors embedded in smartphones,
    - ✓ Enhancing the sense of safety and increasing the elderly independence while being monitored and assisted in indoor and outdoor, using the two lowest-level of Maslow's hierarchy of needs,
    - ✓ Offering tailored services to the actual context situation, need and preferences of an elderly.

Related work

- **Daily life activity tracking application for smart homes using android smartphone (Fahim et al., 2012)**
  - Daily life activity tracking system for an aging society,
  - Sensors such Radio-Frequency Identification (RFID) Tags and cameras located at home,
  - Generation of reminders for scheduled tasks and overlooked medicines,
- **An IoT-aware AAL system for elderly people (Mainetti et al., 2016)**
  - AAL system to assist elderly by tracking them during indoor and outdoor activities,
  - Capturing of sensor data for recognizing their behavioral changes, both in their home and city environment,
  - Triggering of health care notifications when abnormal behavioral change occurs.
- **Real-time human behaviour monitoring using hybrid ambient assisted living framework (Patel et al., 2020)**
  - Hybrid framework for human behavior modeling in AAL,
  - Sensors, i.e., body, object, camera and environmental sensors,
  - Machine Learning and deep Learning approaches to discover the user's indoor activity in a smart home,
  - Providing the essential services like medical assistance or emergency response,

Related work

- **Comparison between discussed AAL approaches**

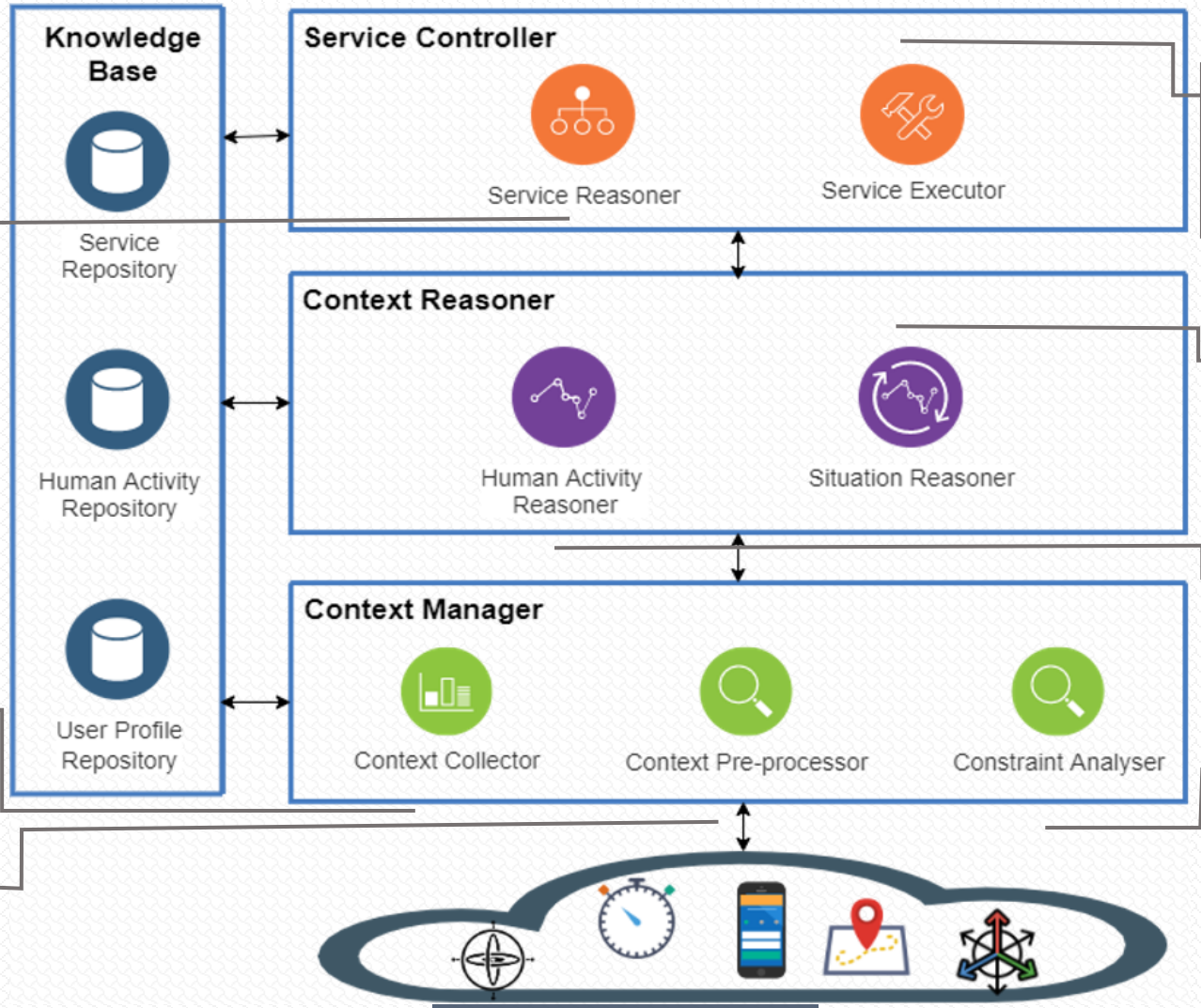
		Fahim et al., 2012	Mainetti et al., 2016	Patel et al., 2020
Assistance		Indoor	Indoor/Outdoor	Indoor
Environment	*Smart*	+	+	+
	Mobile	-	-	-
Sensor		NWS	NWS/WS	NWS/WS
Need level	*physiological*	-	-	-
	safety	~	~	~

(NWS) non-wearable sensor (WS) wearable sensor (-) Unsupported (~) Partially supported (+) Supported

Proposed approach

- **Architecture overview**

Determine which appropriate service should be executed based on the elderly's profile and situation ,



Execute services that are earlier selected on the elderly's mobile device ,

Infer elderly situation based on their available context information,

Predict the current activity of elderly,

Interpret elderly's profile,

Gather sensed data in real-time, such elderly's activity, location and time,

Analyze sensed data,

Proposed approach

- **Elderly Service Identification**

Elderly's physiological needs-related services

Food recommendation services

Exercise recommendation services

Entertainment recommendation services

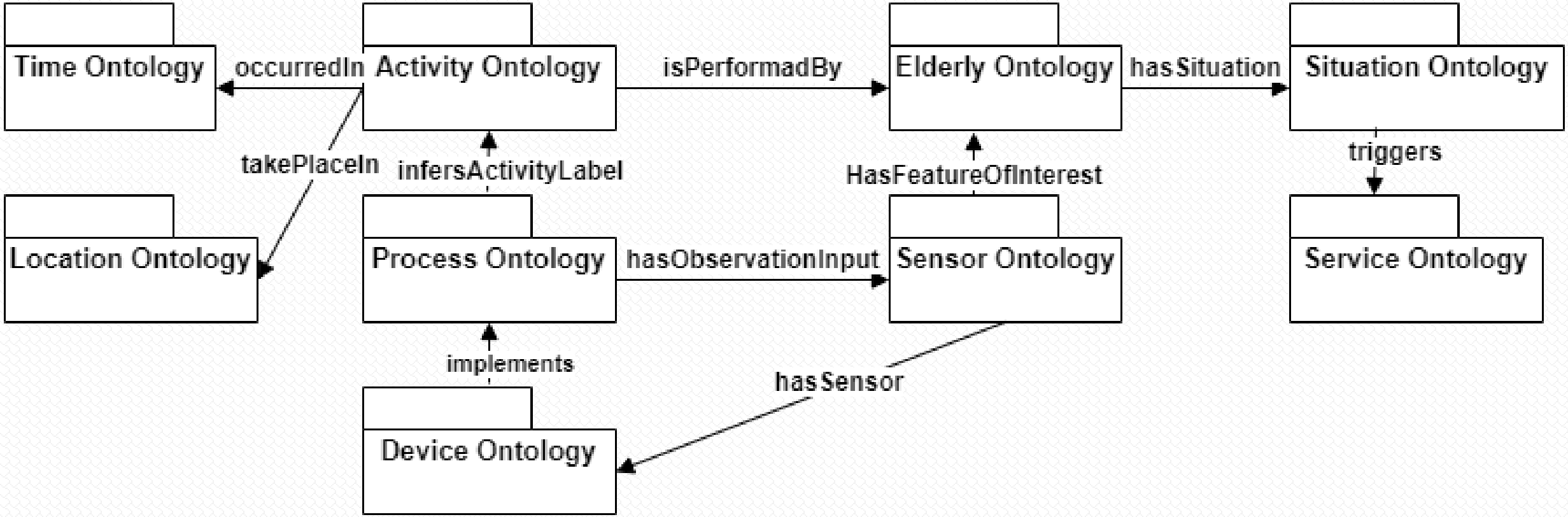
Elderly's safety needs-related services

Health recommendation services

Medication recommendation services

Proposed approach

- **Ontology-Based Model**



Implementation

- A mobile application in Android environment and written in Java,
- A hybrid activity recognition method,
- Smartphone's sensing capabilities as GPS and accelerometer for the localization and the detection of human activity, respectively,
- Integration of the modular ontology previously discussed and a raft of inference rules as shown in this figure,

```
[Music-Service-rule:
(?EldCtx rdf:type uni:ElderlyContext)(?EldProf rdf:type uni:ElderlyProfile)
(?EldPref rdf:type uni:MediaPref)(?EldCtx uni:hasProfile ?EldProf)
(?EldCtx uni:hasConstraint ?EldPref)(?EldPref uni:E-MediaPrefName 'Music')
(?EldSit rdf:type uni:EntertainmentSituation)(?EldSit uni:S-Name 'Entertainment need')
(?EldProf uni:represents ?EldSit)(?EldServ rdf:type uni:ElderlyService)
(?EldServProf rdf:type uni:ElderlyServiceProfile)
(?EldServ uni:hasServiceProfile ?EldServProf)(?ProfileCat rdf:type uni:EntertainmentService)
(?EldServProf uni:hasCategory ?ProfileCat)(?EldServProf uni:hasSituation ?EldSit)
->
(?EldServProf uni:ES-IntendedPurpose 'Music Service')]
```

Figure. An example of inference rule.

Case study

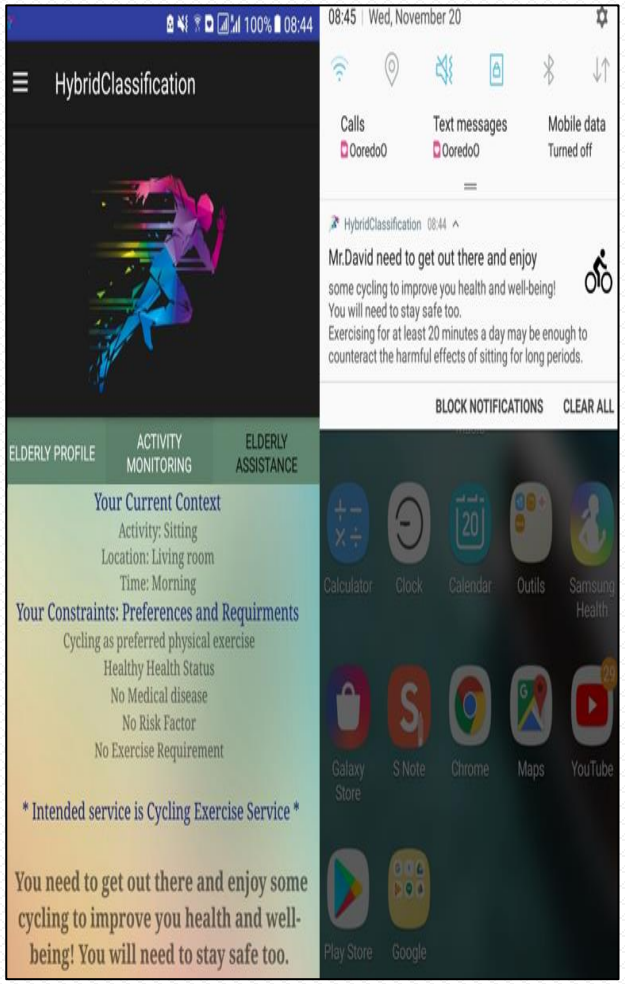
Potentials scenarios

Elderly Context
Location. Living room,
Time. Morning,
Activity. Sitting,

Elderly Constraint
Elderly Preference. Cycling,
Elderly requirement. No required exercise,

Elderly Profile
Healthy status,
No disease,
No risk factor,

Notification service
Cycling exercise. “David, you could get out and enjoy some cycling,”

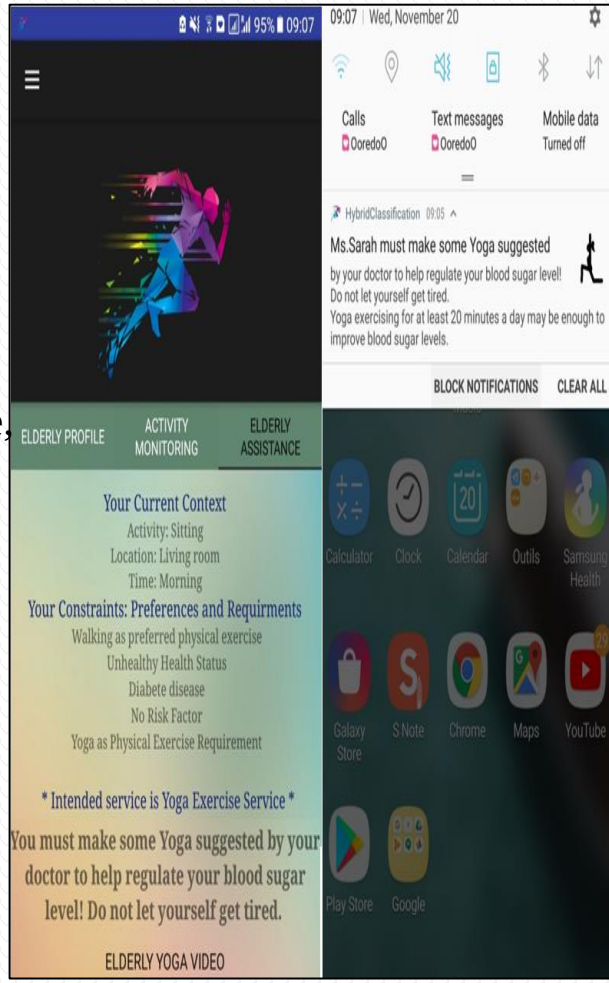


Elderly Context
Location. Living room,
Time. Morning,
Activity. Sitting,

Elderly Constraint
Elderly Preference. Walking,
Elderly requirement. Yoga exercise,

Elderly Profile
Healthy status,
Diabetes disease,
No risk factor,

Notification service
Yoga exercise. “Sarah, you must make some Yoga,”



- **User satisfaction assessment**

CSQ-8

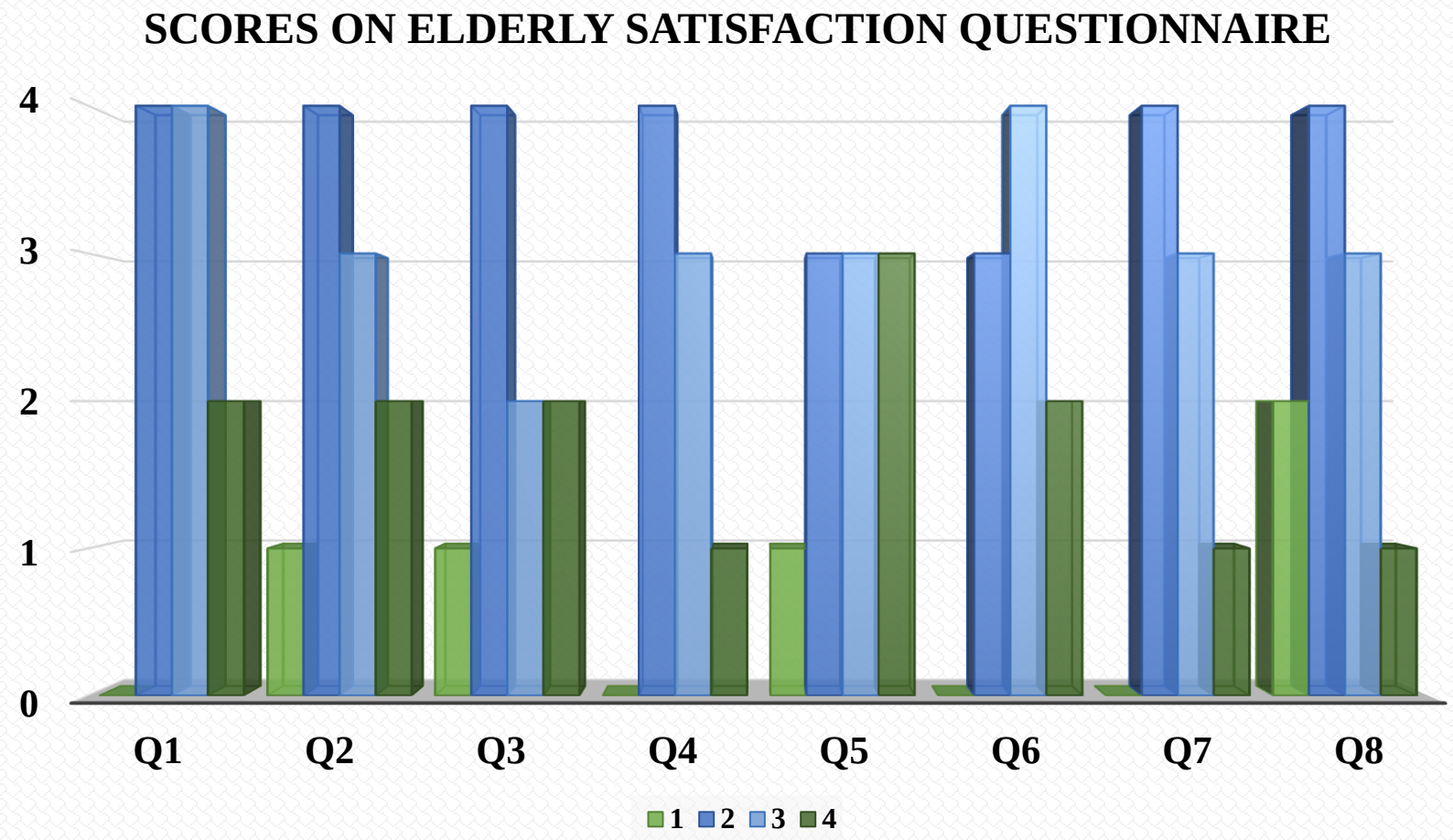
8 questions,
1 - 4 response scale,

10 Elderly

5 with excellent health status,
5 with poor health status (Disease),

Elderly satisfaction evaluation

Mean overall score = 25.8,
Elderly are mostly satisfied,



Conclusion

- AAL system monitors elderly in their mobile smart environments using smartphones,
- AAL system promotes particular service with respect to the elderly's situation,
- Experimental results are introduced that show the effectiveness of our proposed system, where a great number of elderly are satisfied,
- **Limitation**
  - ✓ This approach provides services for elderly with a limited consideration of the Maslow's hierarchy levels, which undertakes less-than ideal evaluation results,
- **Future work**
  - ✓ Extend the applicability of this approach by considering new intelligent elderly services with a consideration of the rest of Maslow's hierarchy levels,
  - ✓ Introduce a dynamic context evolution at runtime for including other kind of smartphone sensors,

Thank you

- **Collaborators**
  - Roua Jabla, Maha Khemaja (University of Sousse), Félix Buendía (Polytechnic University of Valencia), Sami Faiz (University of Tunis El Manar),

- **For more information about the research itself**
  - Smartphone Devices in Smart Environments: Ambient Assisted Living Approach for Elderly People, *Roua Jabla*, *Maha Khemaja*, *Félix Buendía*, *Sami Faiz*,

Any question?