Framework for promoting social interaction and physical activity in elderly people using gamification and fuzzy logic strategy

Juana Isabel Méndez, Pedro Ponce, Omar Mata, and Arturo Molina

School of Engineering and Sciences
Tecnológico de Monterrey, México City

Alan Meier

Lawrence Berkeley National Laboratory
UC Berkeley, California, USA

Therese Peffer

Institute for Energy and Environment
UC Berkeley, California, USA

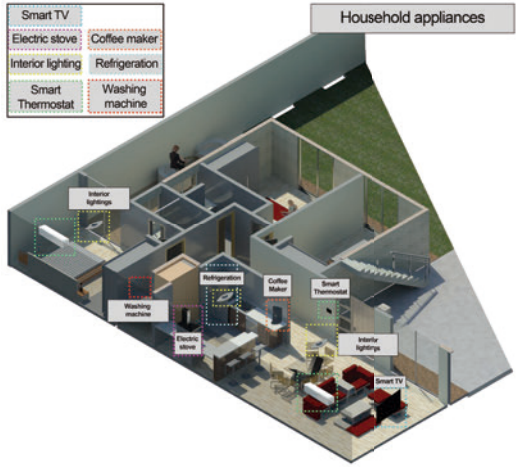
Agenda

- Introduction
- Objective
- Current solution
- Proposed solution
- Methodology
  - Proposed Framework
- Results
- Conclusion
- Future work
- References

Introduction

- Population over **65 years** in the **United States** is projected to increase from **18% to 26% by 2050.**

- **Elderly people** spend **more time** at their **home** than any other family members.



https://www.centreforbrainhealth.ca/news/2018/06/21/new-paper-offers-smart-guidelines-developing-tech-tools-older-adults

- **Thermostats** are used in **85%** of **residential buildings** in the **United States.**

- **New household products** and applications are appearing due to advances in tehcnology

- **e-Health applications: Improve quality of life by** promoting **routine exercises**.

- **Elderly people failed** in adopting **new technologies** due to **lack of technological skills** causing **social isolation.**

Introduction

- The **acceptation** of a product relies on **personality traits.**
- **Gamification** within **a device** may increase **enjoyment** in elderly users.
- **Gamification** with **fuzzy logic** has been proved to be **useful** in the **decision making process**, such as **profiling the type of user** for the personnel selection process.
- **Nevertheless**, to the best of our knowledge, applying a **gamification** strategy based **on fuzzy logic** and **the type of personality** to **develop** a **tailored product** has **not been studied previously.**

Personality traits in e-Health applications for elderly users

Neuroticism (N)	They are not attracted to learn and try new things.
Agreeableness (A)	They are not attracted to technology; however, some of them are barely attracted to learn new things.
Openness (O)	Can or cannot be attracted to use Internet
Conscientiousness (C)	Attracted to learn and engage in activities, but they require to be convinced on the usefulness of the technology.
Extraversion (E)	They are extremely attracted to learn and try new things. They are a pro-technology user.

Objective

Propose a **strategy** that promotes **regular physical activities** and **social interaction** by considering the **elderly's personality traits**, the use of **gamification** techniques in mobile interfaces and the **connected thermostat**, to **teach, engage,** and **motivate** them to have a **healthier lifestyle**

Current Solution

ENABLE project

Safety and assistive technologies for monitoring and controlling bath, temperature and gas stove.

Silver Promenade

Video game that simulated real-life activities.

2003 | 2008 | 2012 | 2017

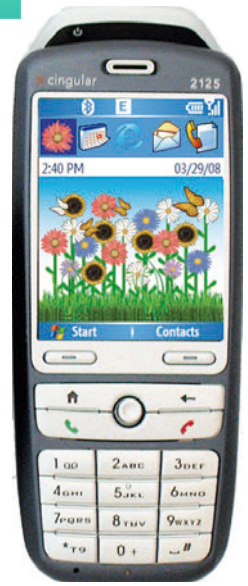
UbiFit Garden

On-body sensing, activity inference and mobile to promote physical activity.

Spirit50

Online application for elderly people to promote physical activity.

2008

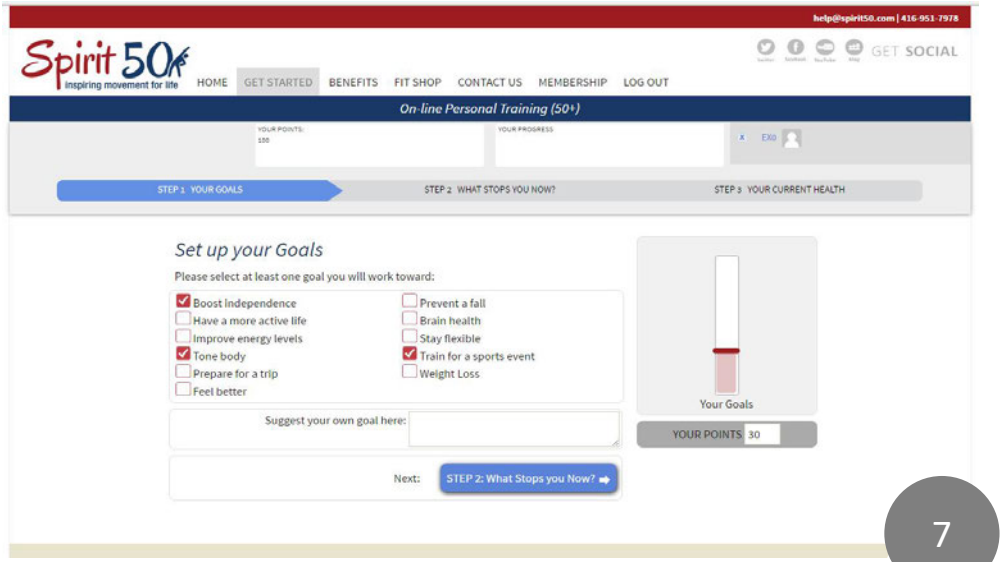


https://www.consolvo.org/ubifit

2012

http://gamification-research.org/wp-content/uploads/2011/04/12-Gerling.pdf

2017



http://hcigames.com/research/gamification-of-physical-activity-www-spirit50-com/

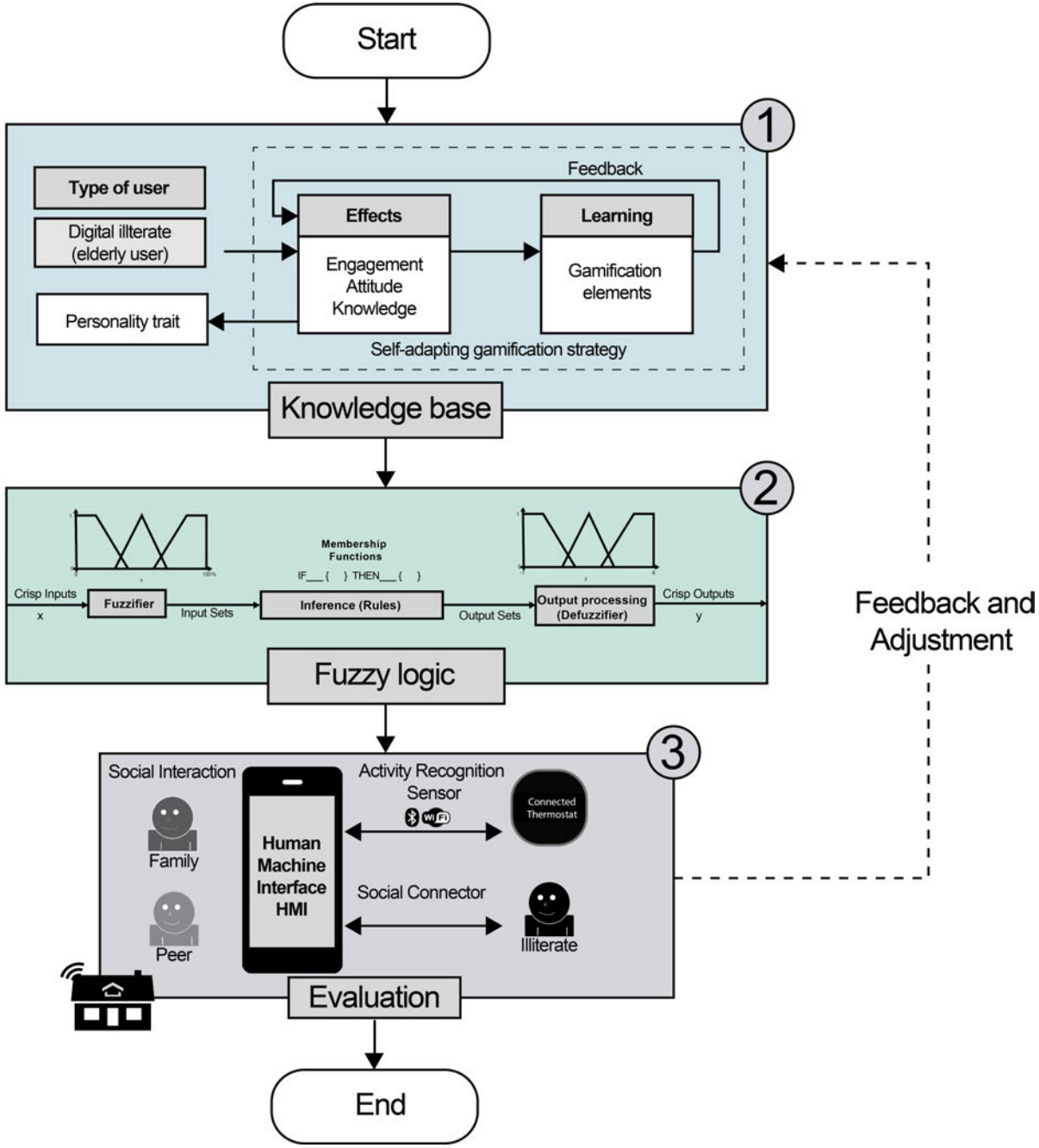
Proposed Solution

Develop a **framework** that considers **the type of personality** using a **gamification strategy** based on **fuzzy logic** to propose **a tailored Human Machine Interface.**

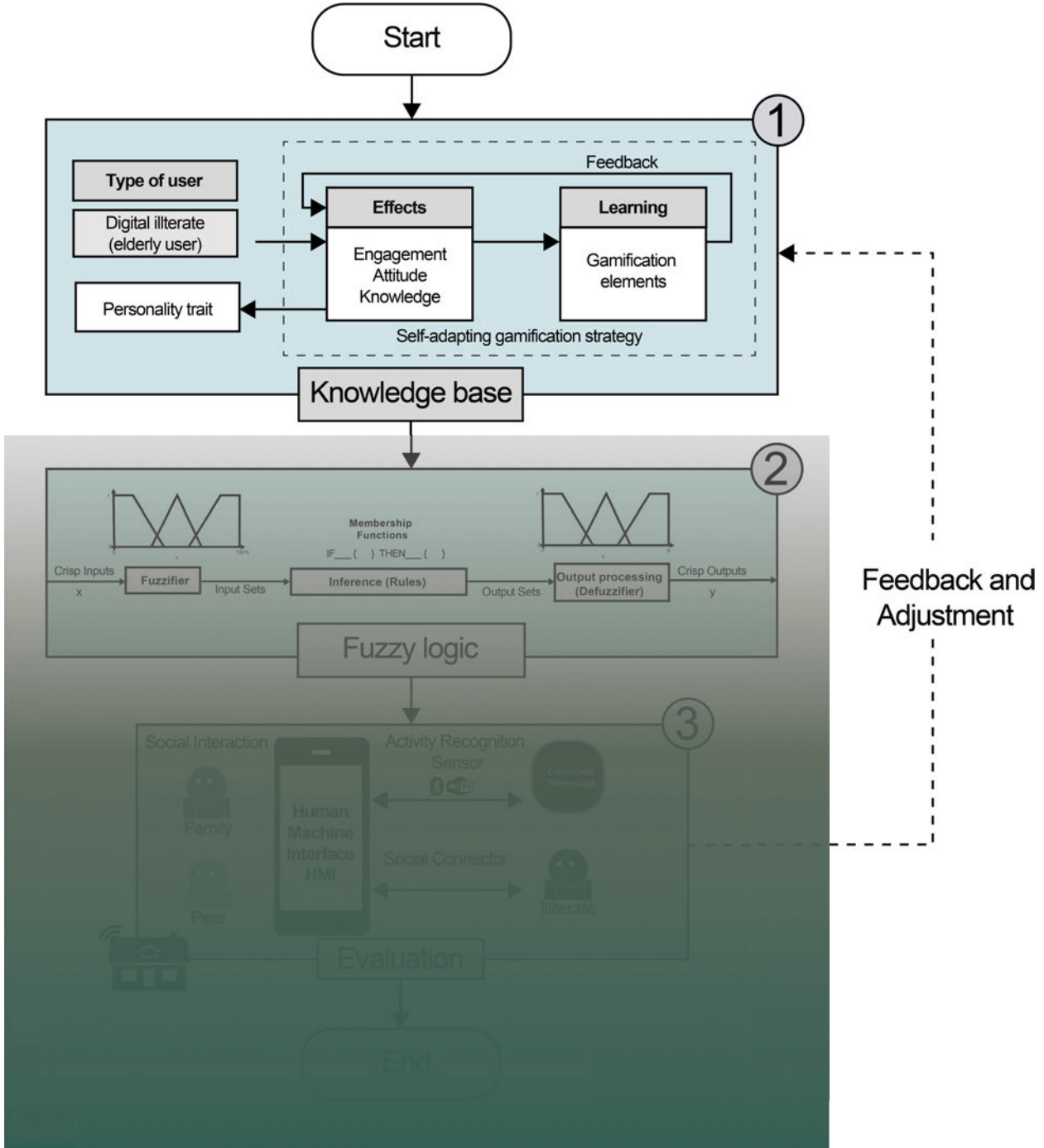
Methodology

Collection of data from books, journals and proceedings publications:

- The collected data was gathered from surveys, interviews and meta-analysis
- Gamification elements in e-Health applications for the elderly.
- Types of Gamification frameworks.
- Personalities for elderly people regarding their attitude, engagement, and knowledge about using the Internet for health purposes.
- The evaluation and metrics used in those publications to validate the HMI.

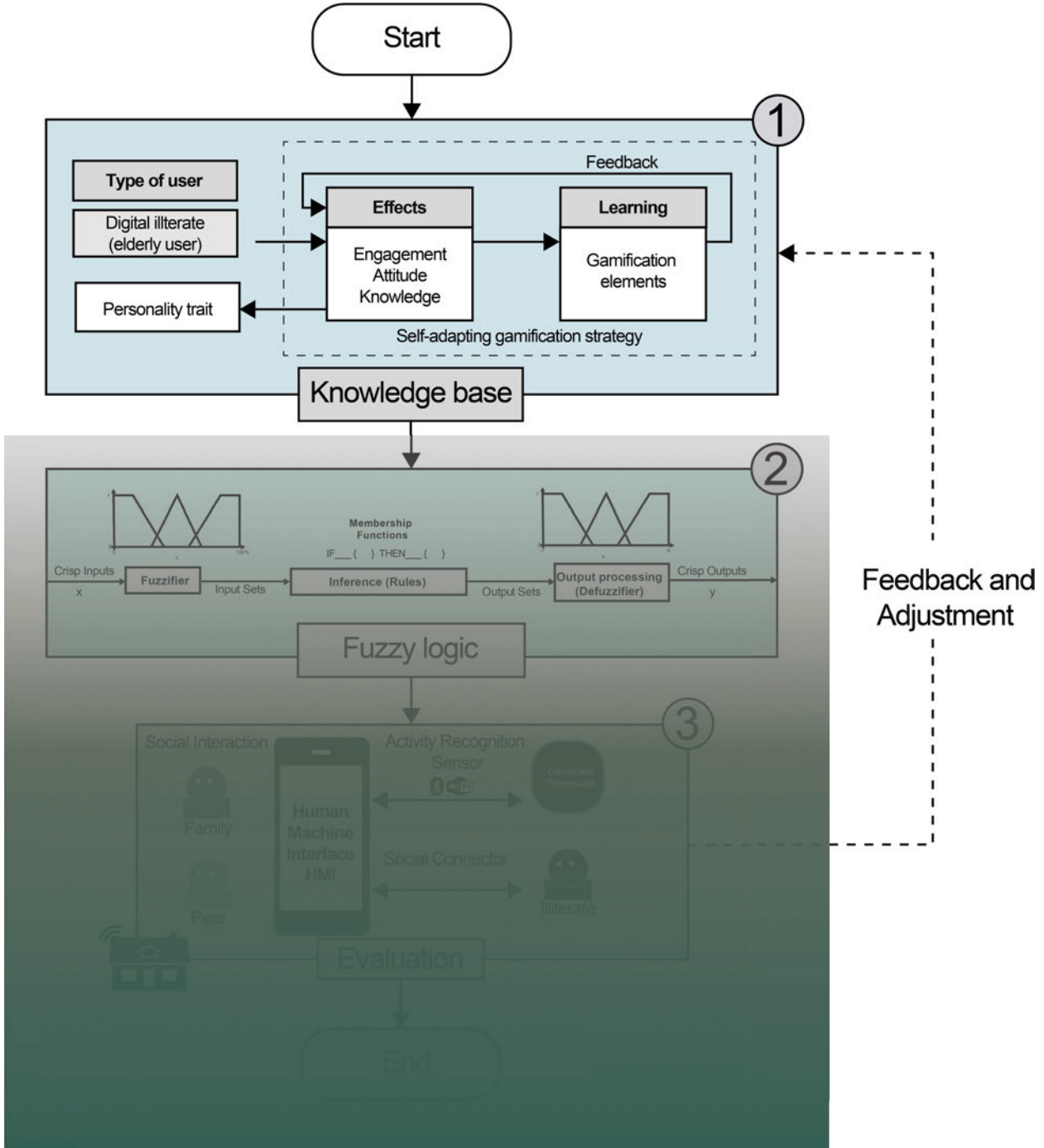

Start
1
Type of user
Digital illterate (elderly user)
Personality trait
Feedback
Effects
Engagement
Attitude
Knowledge
Learning
Gamification elements
Self-adapting gamification strategy
Knowledge base
2
Membership Functions
IF___{ } THEN___{ }
Crisp Inputs
x
Fuzzifier
Input Sets
Inference (Rules)
Output Sets
Output processing (Defuzzifier)
Crisp Outputs
y
Fuzzy logic
3
Social Interaction
Family
Peer
Human Machine Interface HMI
Activity Recognition Sensor
Connected Thermostat
Social Connector
Illiterate
Evaluation
End
Feedback and Adjustment

Framework



1

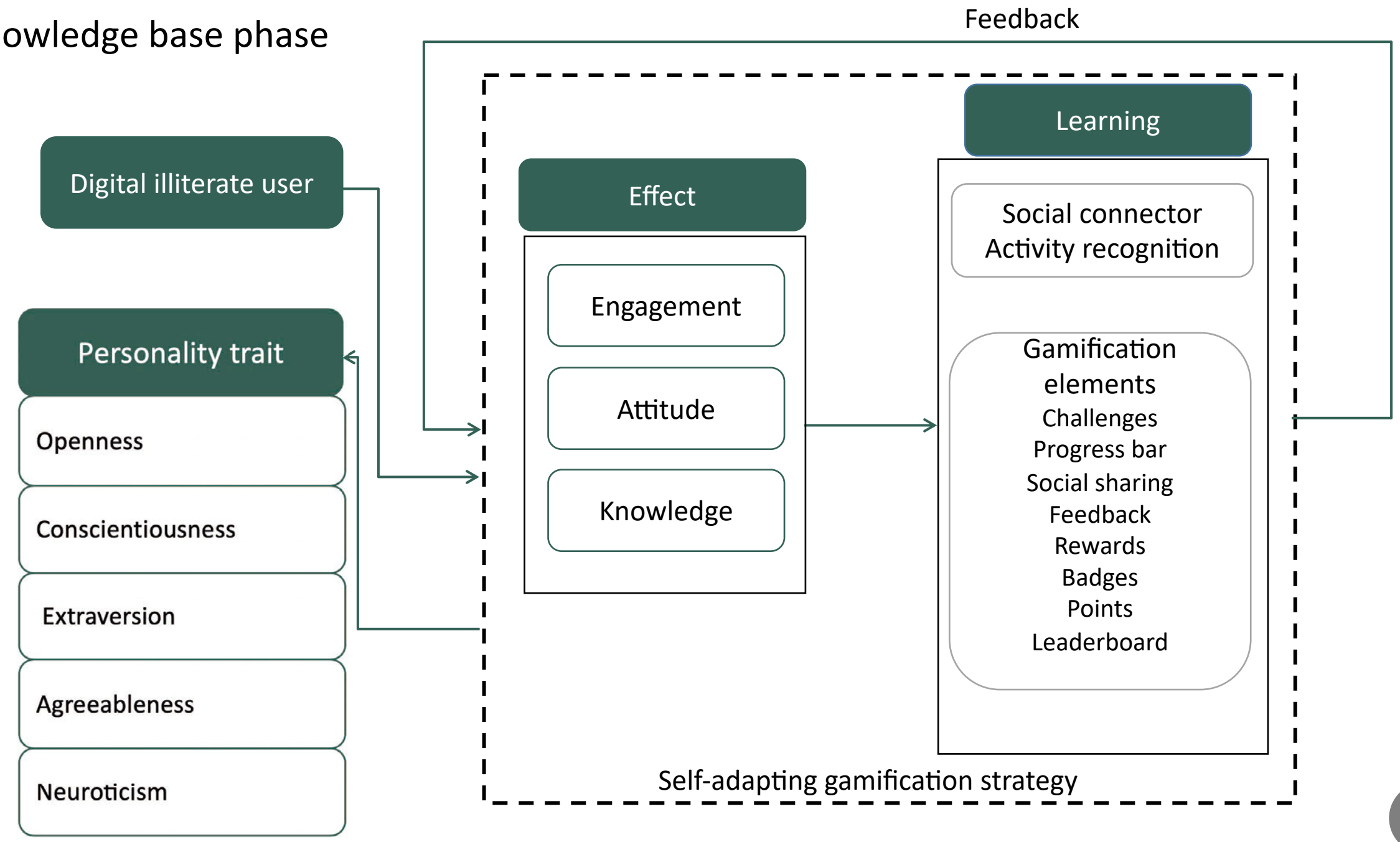
Knowledge base phase

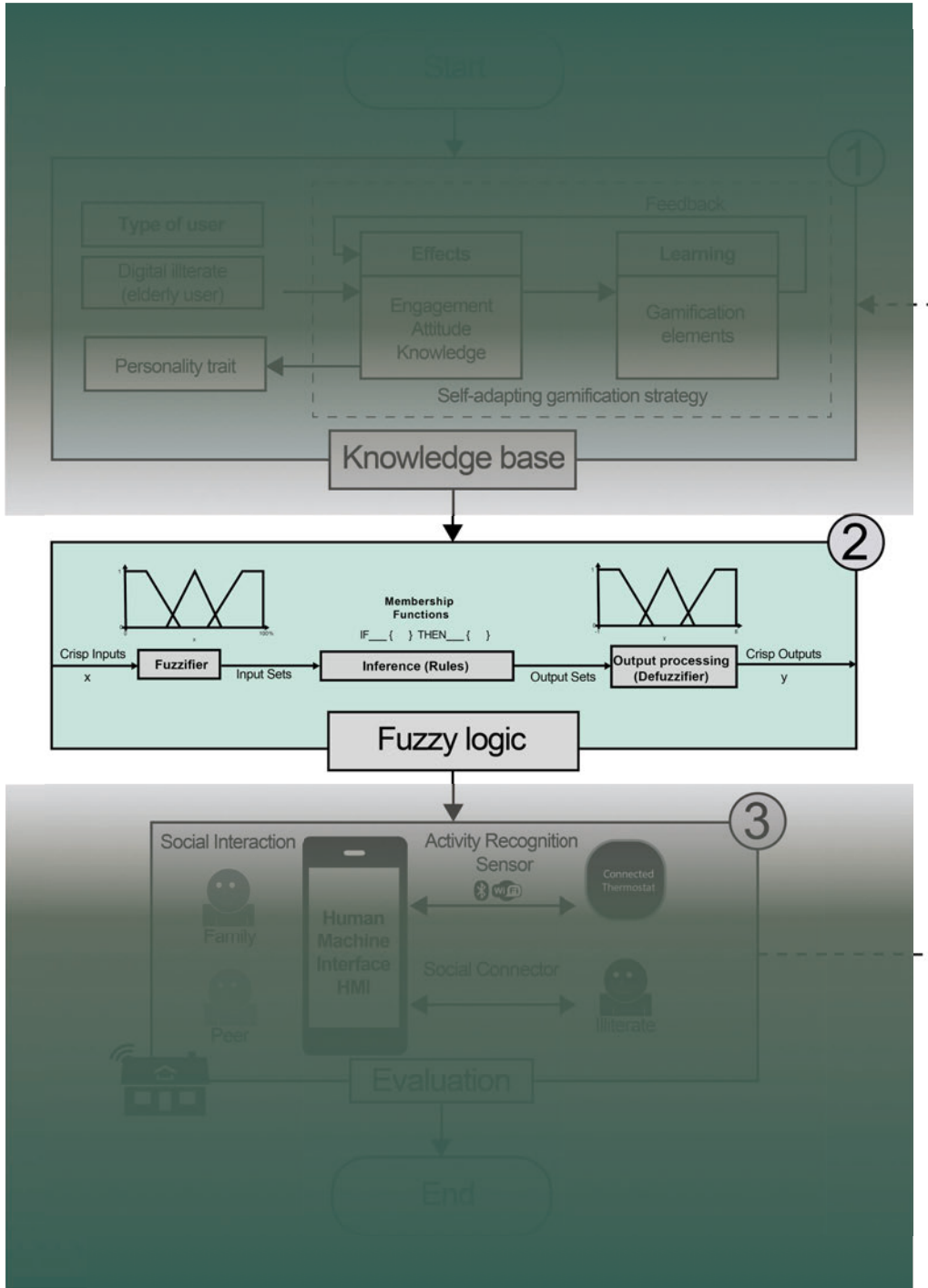


1

Analyzes the types of personalities, as well as the effects of the application, and the gamification elements used in e-Health applications for elderly.

Knowledge base phase

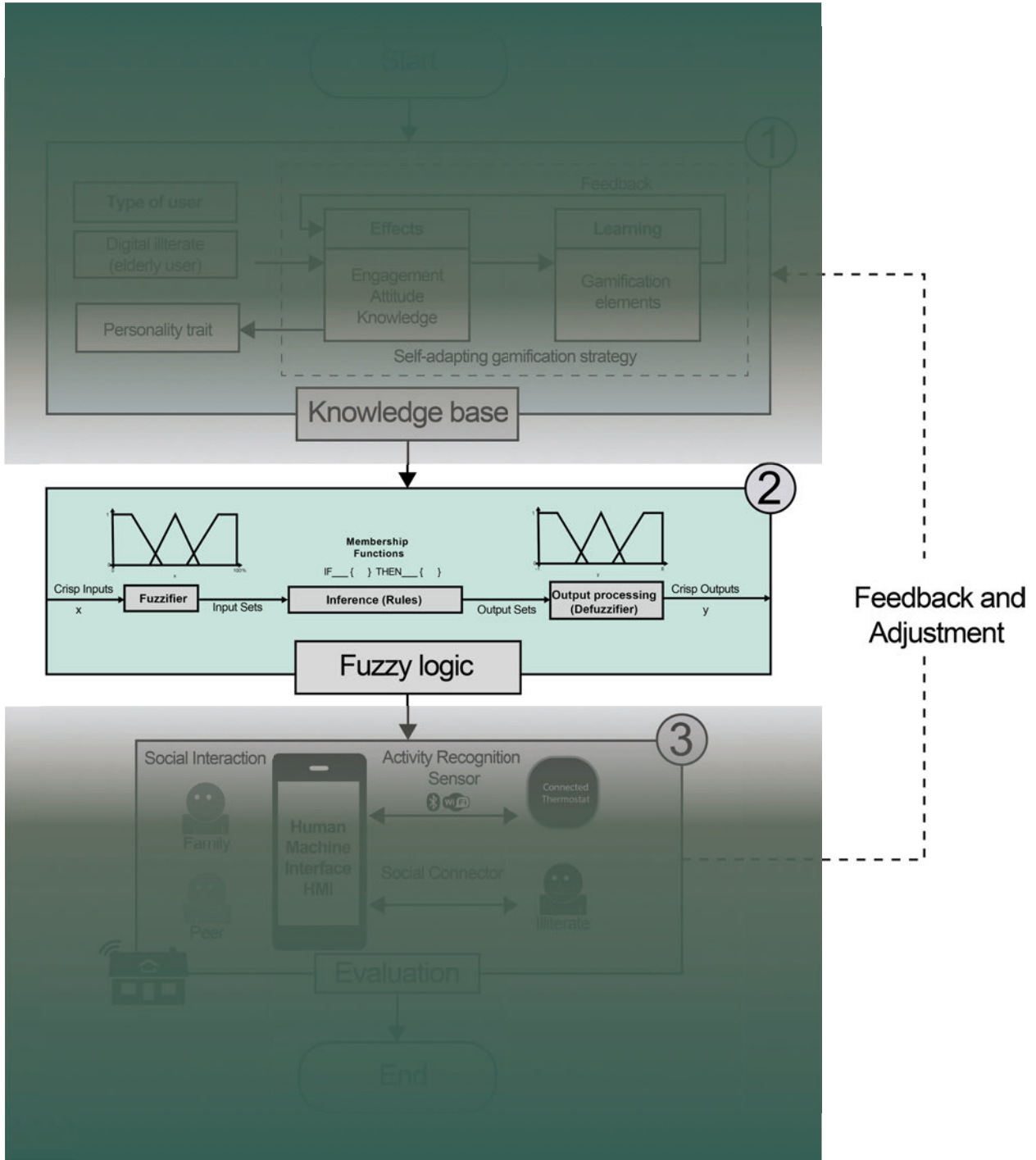




Feedback and Adjustment

2

Fuzzy logic phase



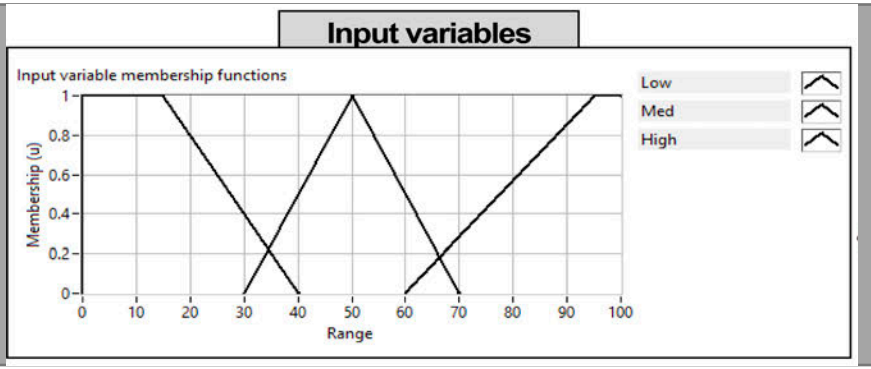
2

- L. Zadeh (1965) proposed a fuzzy set theory that models uncertainty based on linguistic variables related to human reasoning. It does not require a mathematical model of the real system to develop the set, but the experts' knowledge to propose the system.
- This step analyzes the effects of the game to propose the gamification elements that best fit the user type.
- The fuzzy system helps the designer propose a tailored interface.

Knowledge

Measures the completed routine exercises and the acquired expertise they share with friends.

Input elements



Challenges

Progress bar

Badges

Points

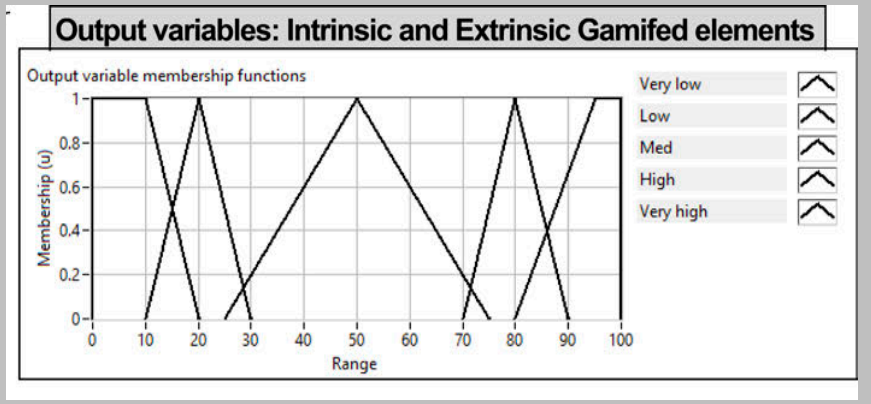
Leaderboard

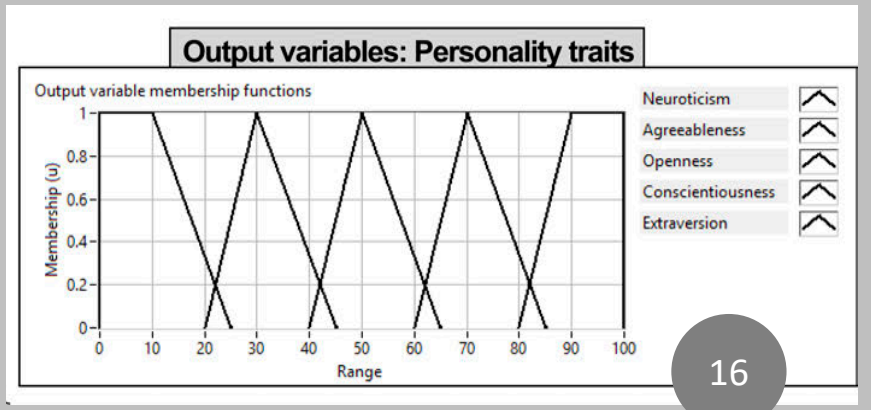
Rewards

Personality trait

Output elements

- The more completed challenges, the more knowledge the user has.
- Through the number of badges, points, and rewards achieved.
- Advances in the leaderboard reflect the understanding of physical activities.

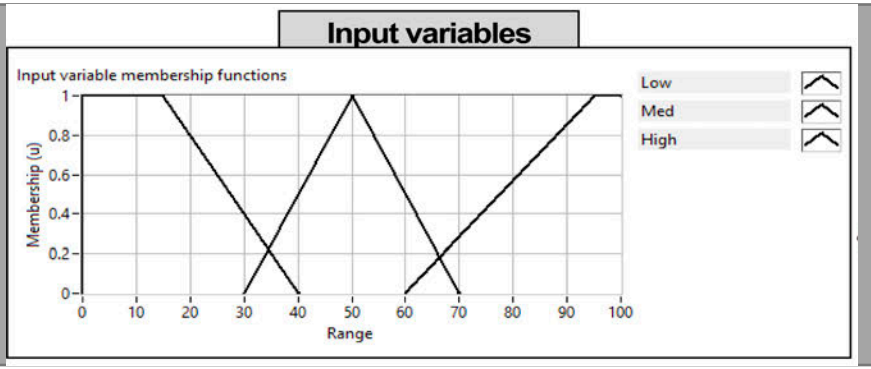




Attitude

Measures if the user is having an attitude change toward exercising

Input elements



Progress bar

Social Sharing

Feedback

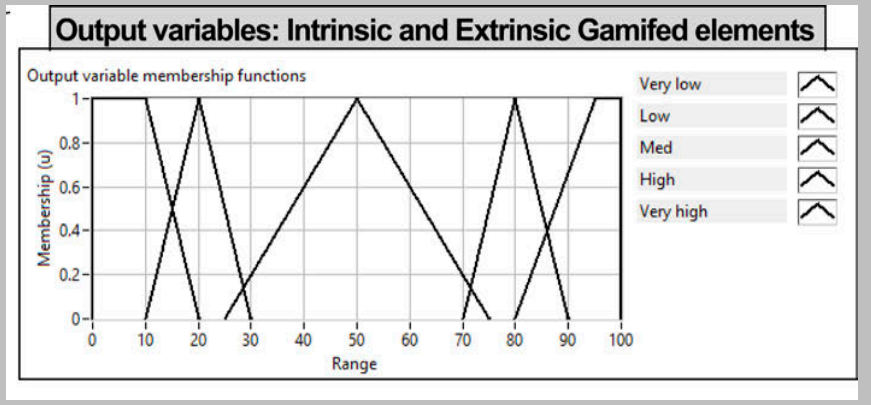
Badges

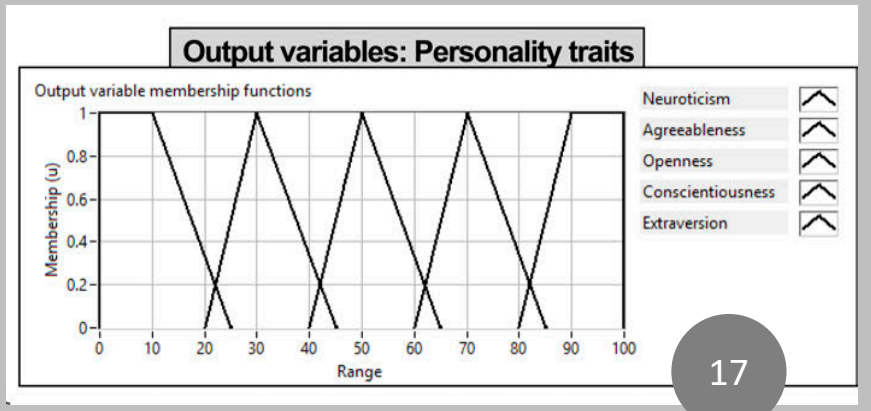
Points

Personality trait

Output elements

- Through progress bar the elderly can track advances.
- Elderly users share with peers their improvements and the benefits they are achieving.
- The elderly can give their friends feedback on how they complete the exercises or activities and vice versa.
- The badges and points earned reflect that the elderly users are performing the exercise.

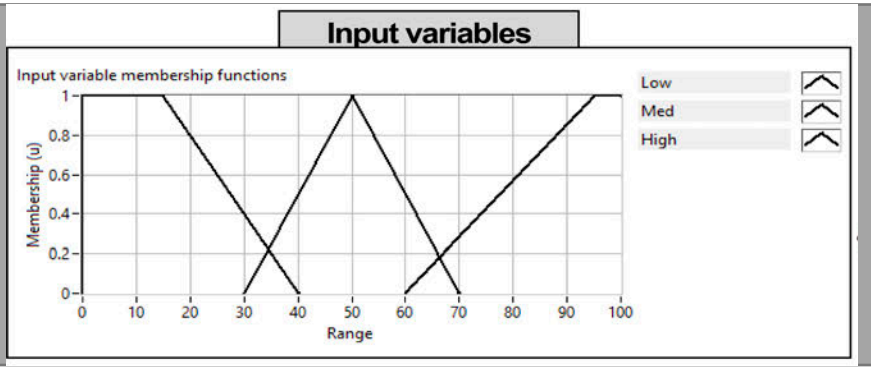




Engagement

Monitors the time the elderly uses the application.

Input elements



Challenges

Social Sharing

Feedback

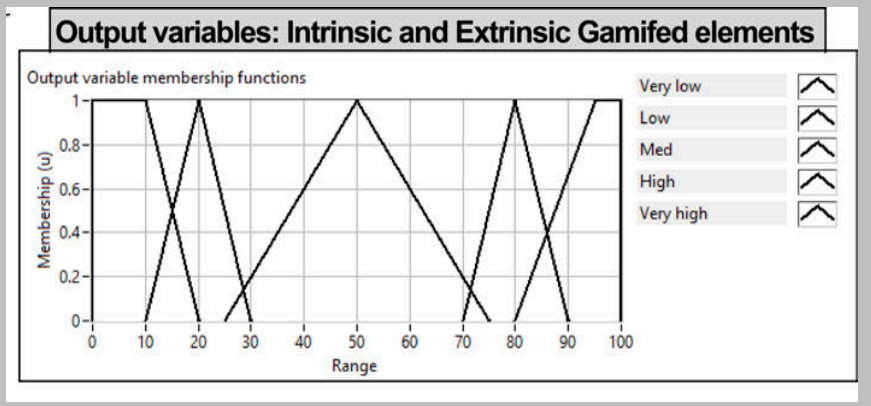
Leaderboard

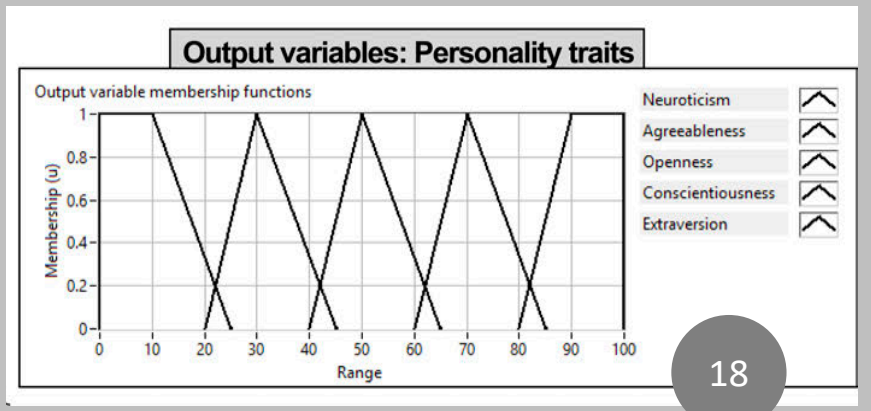
Rewards

Personality trait

- Through challenges achieved and time dedicated.
- Through video calls duration or feedbacks done to elderly Friends and vice versa.
- By monitoring the ascense to the top.
- The more rewards is recieving the more engaged the user is.

Output elements

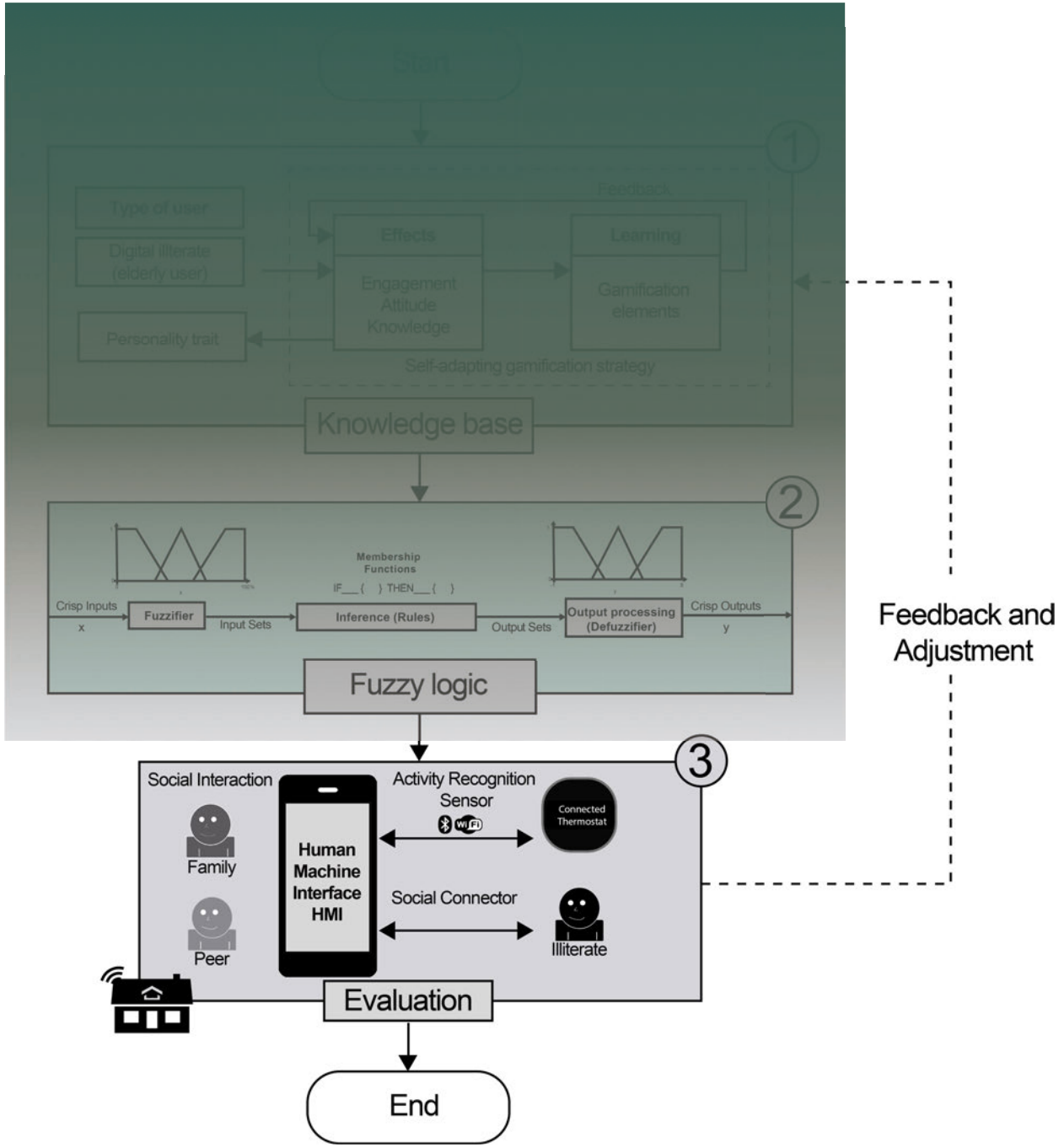




Input elements

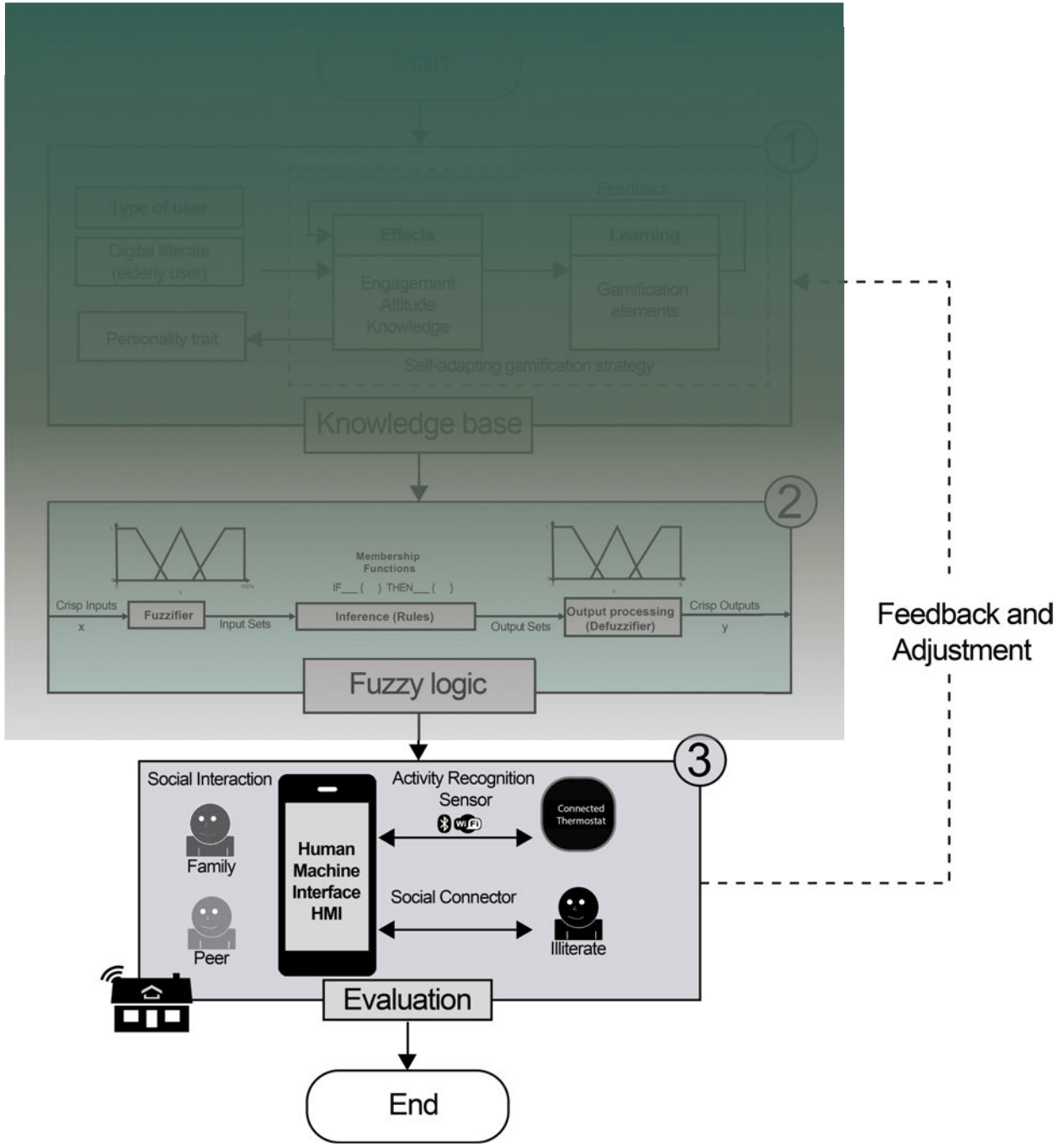
Output elements

	Attitude	Knowledge	Engagement	Characteristics
Neuroticism (N)	Low	Low	Low	They are not attracted to learn and try new things.
Agreeableness (A)	Low	Low	Med	They are not attracted to technology; however, some of them are barely attracted to learn new things.
Openness (O)	Med	Med	Med	Can or cannot be attracted to use Internet
Conscientiousness (C)	Med	High	High	Attracted to learn and engage in activities, but they require to be convinced on the usefulness of the technology.
Extraversion (E)	High	High	High	They are extremely attracted to learn and try new things. They are a pro-technology user.



3

Evaluate phase



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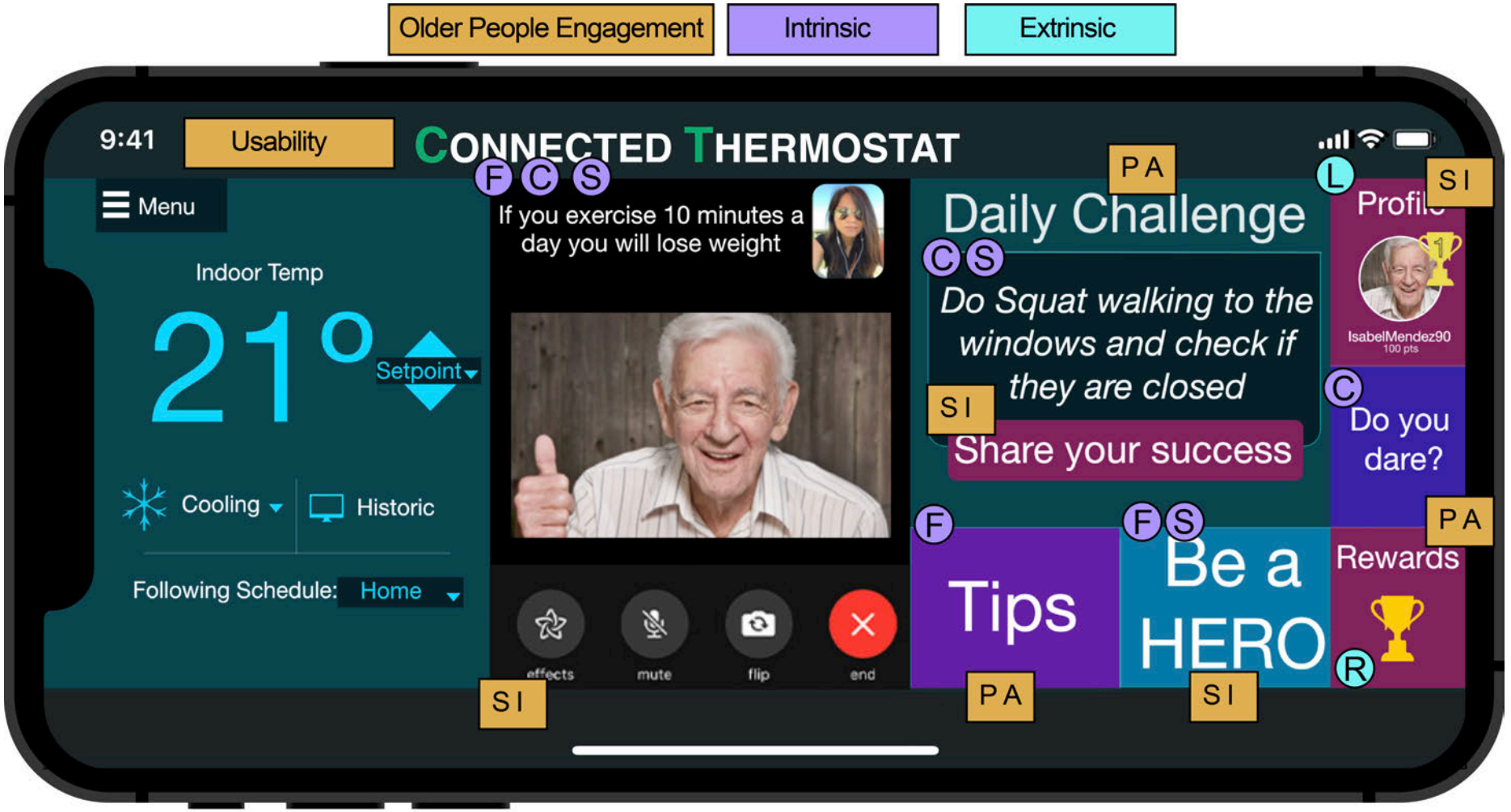
- The HMI is proposed so the end user interacts with the application.
- This phase provides continuous feedback to the user and the knowledge base to determine whether the user is engaged or if adjustments are required.

Results

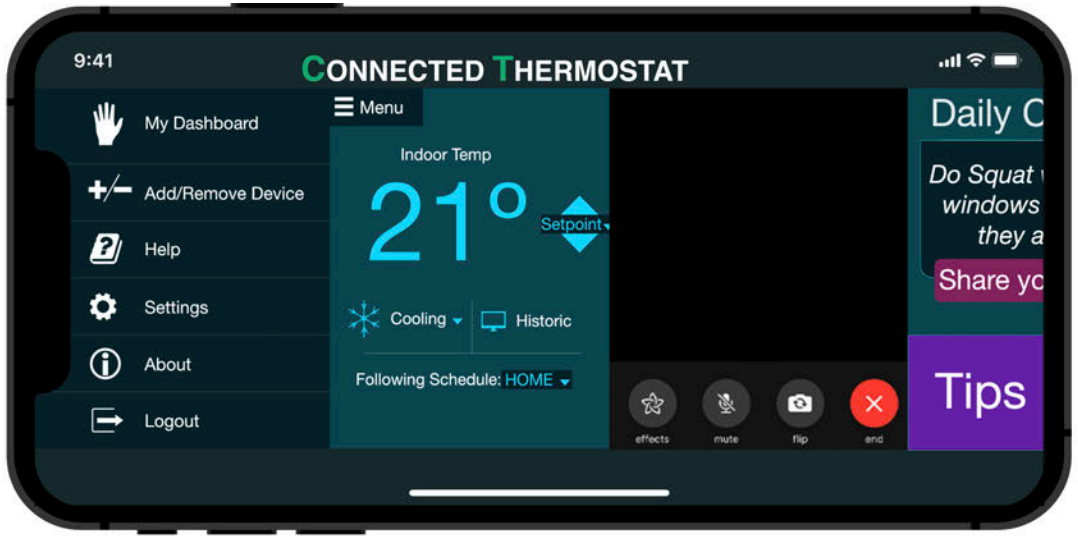


Personality trait

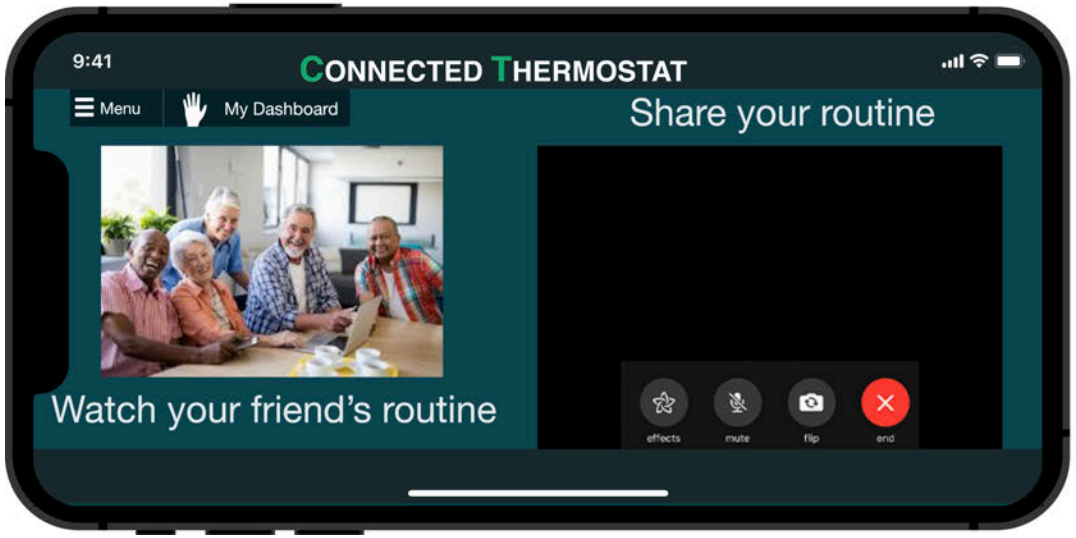
Openness

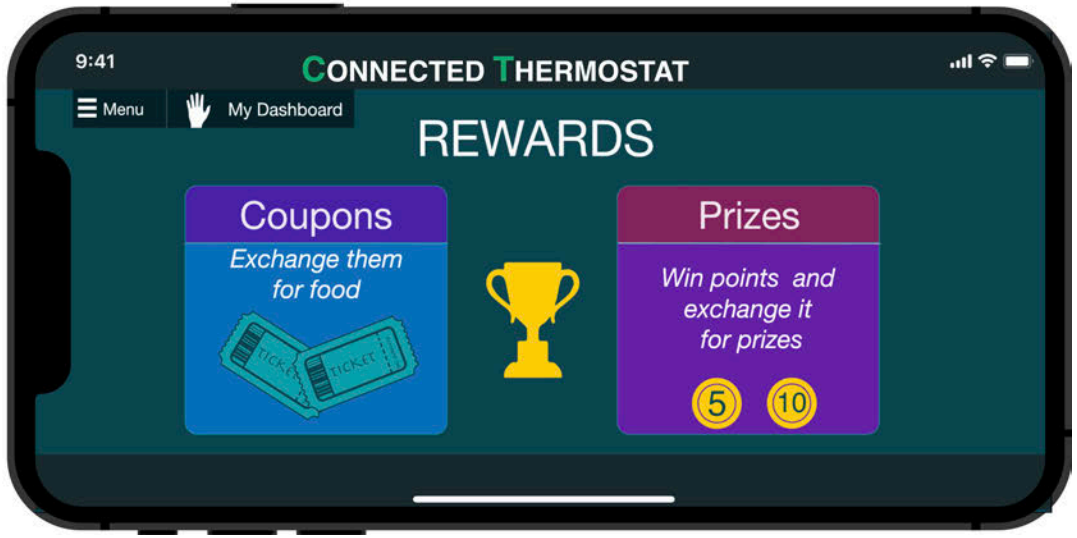
Conscientiousness

Results

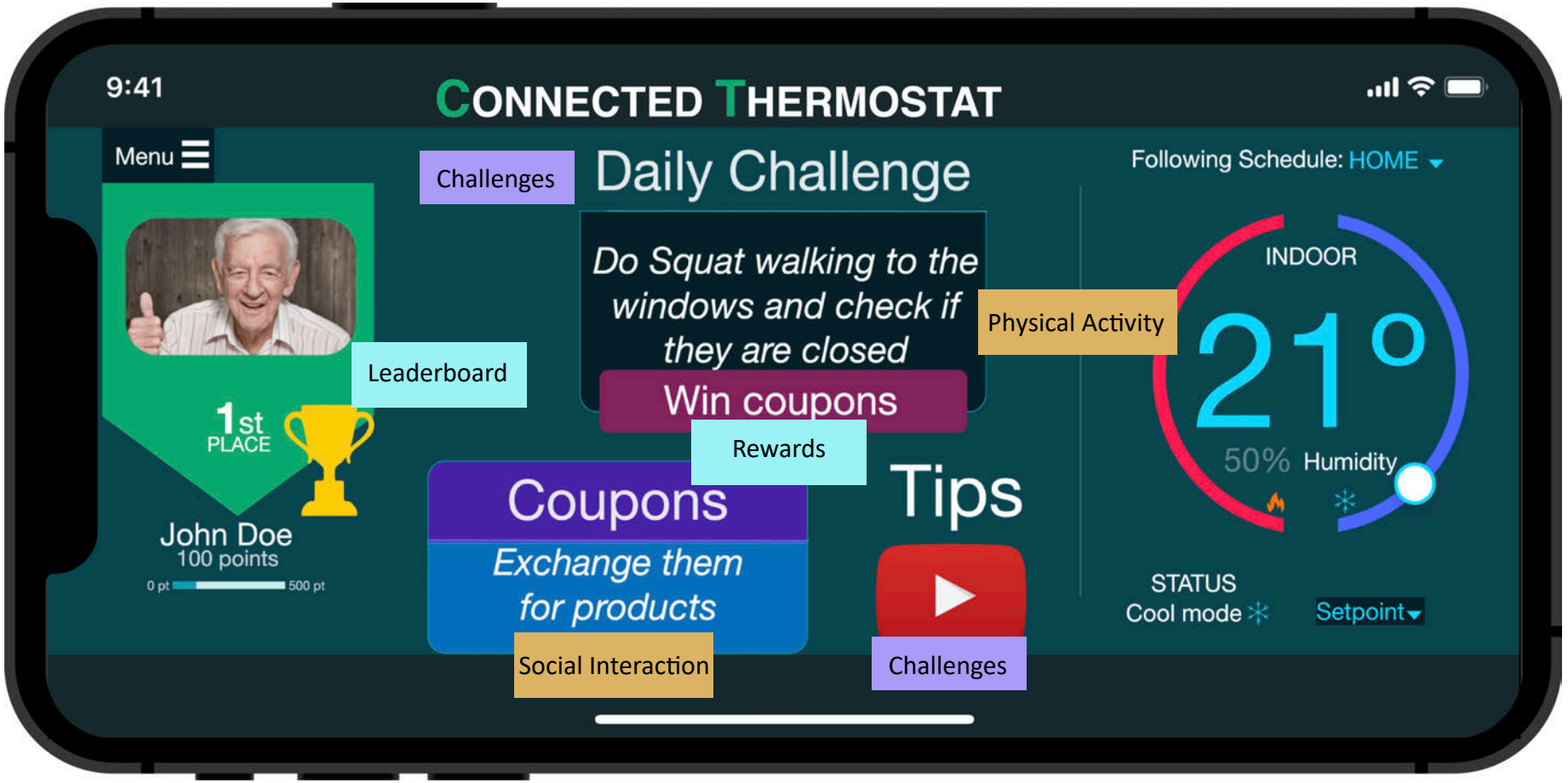

9:41
CONNECTED THERMOSTAT
My Dashboard
Add/Remove Device
Help
Settings
About
Logout
Menu
Indoor Temp
21°
Setpoint
Cooling
Historic
Following Schedule: HOME
effects
mute
flip
end
Daily C
Do Squat
windows
they a
Share yc
Tips


9:41
CONNECTED THERMOSTAT
Menu
My Dashboard
TIPS
Share your progress


9:41
CONNECTED THERMOSTAT
Menu
My Dashboard
Share your routine
Watch your friend's routine
effects
mute
flip
end


9:41
CONNECTED THERMOSTAT
Menu
My Dashboard
REWARDS
Coupons
Exchange them for food
TICKET
Prizes
Win points and exchange it for prizes
5
10

Results



Personality trait

Agreeableness

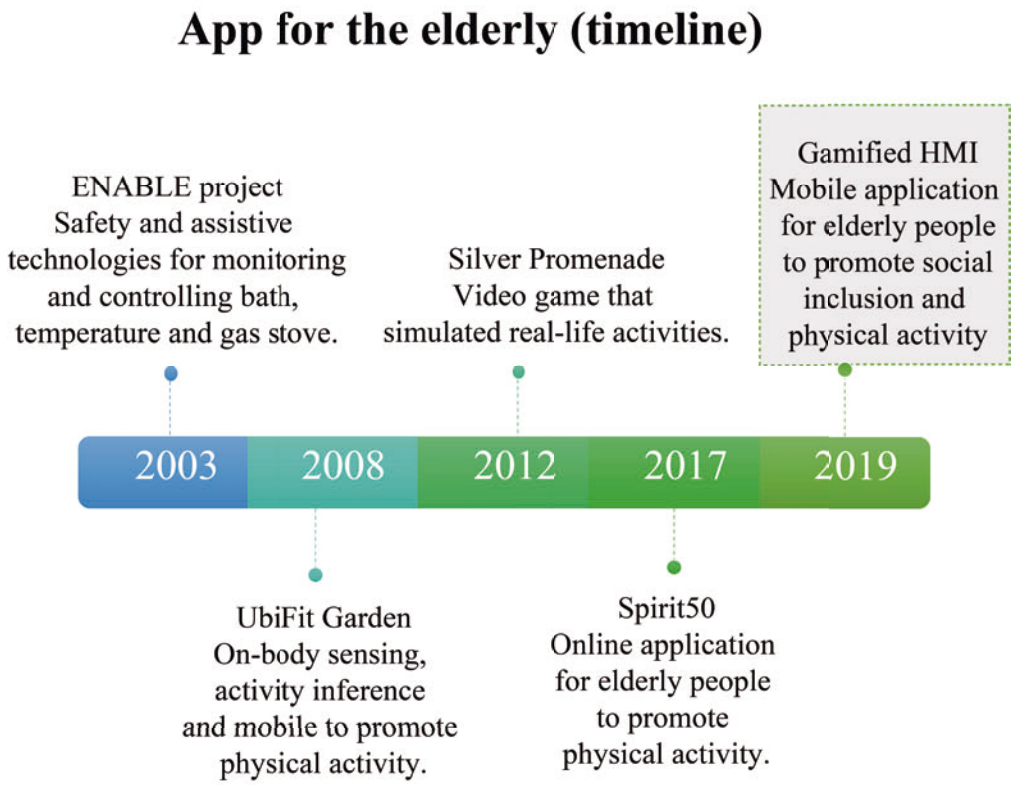
Conclusion

- This framework facilitates the adoption of HMI by taking advantage of a connected device that provides elderly people with an interface according to their personality characteristics.
- This interface teaches, engages and motivates the elderly achieve a healthier lifestyle.
- The customizing method for each type of personality trait is by using fuzzy logic that defines the gamification elements required to promote exercise in the elderly and social interaction.

- This framework interacts with a single device; however, further research is needed to propose interaction between devices.
  - It can be optimized by applying an Artificial Neural Network that analyzes and considers the user's needs and expectations.
- Moreover, the interface only considers the elderly as the main interactor; thus, this interface is not customized for younger users.
  - Besides, the HMI can be optimized using the principles for interaction design to propose a more appealing interface.

Future work

- Design the interface considering the Nielsen's heuristics design.
- Use an ANN for the collected data in the knowledge base step.
- Validate the design interface with the elderly users.
- Launch the app in the market.



Thank you

Contact: A01165549@itesm.mx

Tecnológico de Monterrey + Berkeley UNIVERSITY OF CALIFORNIA

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