

Software Requirements Specification

YOLO

Fazlı Balkan 2380178
Tunahan Dünder 2380319

Table of Contents

1 Introduction

1.1	Purpose of The System	5
1.2	Scope	5
1.3	System Overview	6
1.3.1	System Perspective.....	6
1.3.2	System Functions.....	17
1.3.3	Stakeholder Characteristics	18
1.3.4	Limitations	19
1.4	Definitions	20

2 References

3 Specific Requirements

3.1	External Interfaces	21
3.2	Functions	23
3.3	Usability Requirements.....	36
3.4	Performance Requirements	37
3.5	Logical Database Requirements	37
3.6	Design Constraints	41
3.7	Software System Attributes	41
3.8	Supporting Information.....	42

List of Figures

1	Context Diagram	6
2	External Interfaces Class Diagram	10
3	Use Case Diagram	11
4	Sequence diagram of "Contrast"	12
5	Sequence diagram of "Releasea Product"	13
6	Logical Database Requirements Class Diagram	14

List of Tables

1	System Functions	18
2	Definitions	20
3	Use-Cases	25

1 Introduction

1.1 Purpose of The System

The purpose of the system is to design and develop a toy in order to encourage creativity among children by allowing them to create stories via YOLO. Moreover, YOLO's AI system responds to children's emotional state such that it chooses among Exuberant, Aloof, and Harmonious state. Furthermore, by detecting the children's stories YOLO's AI system chooses contrast or mirroring action.

1.2 Scope

In the scope of this system, it aims to contribute to the children's psychological development by allowing them to explore their deep emotions. For example, imagine a child that is behind from his/her peers in emotional development, YOLO can be used for children to understand their emotions and imagination. It can also be used by psychologists or pedagogue to observe children's psychological state.

YOLO accomplished to contribute to the children's psychological development by its advanced AI and control system. For example, in order to simulate a different perspective of a story YOLO acts in contrast action such that it moves different from the children's movements.

This scope can be extended. For example, in a story which a child created YOLO can simulate different social profiles to exhibit social behaviors, which can contribute child to experience distinct emotional actions. It also enriches the story of the child.

1.3 System Overview

This section of the document will provide detailed information about the system including all components

1.3.1 System Perspective

YOLO does not use much of an external device such that any online service, database etc. However, it uses some internal devices such as its AI system and controller. YOLO's AI system plays a big role in deciding the social state and actions. This action is performed by YOLO's controller.

YOLO is an open source project, which means that a developer can modify it to improve and add new functionalities such as new action type or a new social state

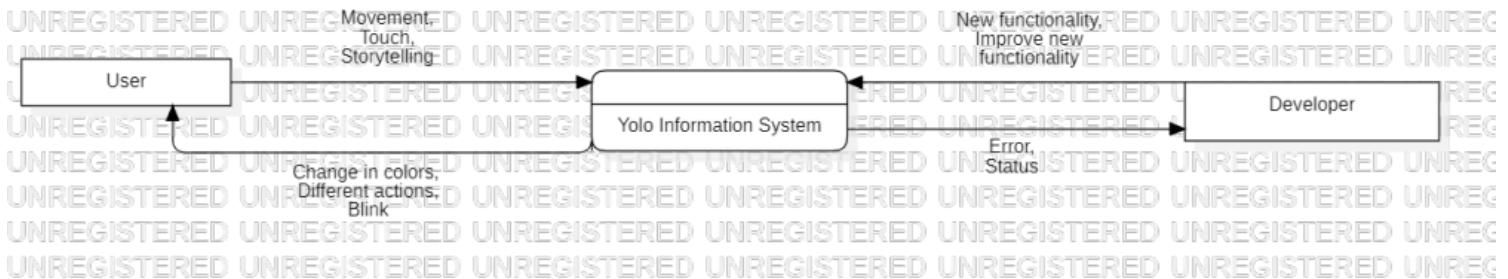


Figure 1: Context Diagram

1.3.2 System Functions

Function	Summary
Open YOLO	When user wants to activate YOLO, s/he only needs to touch the YOLO.
Contrast action	YOLO's AI system chooses contrast action from the user's input which are user movements and touches.
Mirroring action	YOLO's AI system chooses contrast action from the user's input which are user movements and touches.
Exuberant social state	YOLO tries to keep up with the story that is lively, happy and fast. This allows user to experience more realistic stories. YOLO displays vibrant purple and red colors with high brightness levels
Aloof social state	YOLO tries to keep up with the story that is socially reactive and shy. This allows user to experience more realistic stories. YOLO displays cold colors such as green and blue with low brightness levels.
Harmonious social state	YOLO tries to keep up with the story that is in between the Aloof and Exuberant. This allows user to experience more realistic stories. YOLO displays warm colors such as yellow and orange at medium brightness levels
Developer	YOLO as an open source gives developers the chance to improve and add new functionalities to it.

Table 1: System Functions Table

1.3.3 Stakeholder Characteristics

The target stakeholders can be divided into two groups as developers and users. Firstly, developers use that device in order to improve and add new functionalities. In this way, they personalize the YOLO on their purpose. On the other hand, users, children, use YOLO to create stories which helps them to stimulate their imaginations and emotional development.

1.3.4 Limitations

Regulatory policies: There might be some governmental permissions that YOLO has to take in order to gain access for itself to be used in psychological research.

Hardware limitations: There may be some movements that cannot be performed by YOLO because of its wheel and actuator design. Moreover, since the microcontroller used in YOLO is not as advanced as an actual computer, its AI system is limited in computation aspect.

Connection with router: In order for YOLO to receive and response to the user input, it has to be in the range of the router.

Battery life: In order for YOLO to work, it needs to be recharged periodically at every 7 hours when it is actively used.

1.4 Definitions

Term	Definition
AI System	Artificial intelligence system. In an abstract way, it is the brain of the YOLO. It decides which action should be taken in any moment.
Controller	It performs the action that is decided by the AI system
API	Application Programming Interface
YOLO	Your Own Living Object

Table 2: Definitions Table

2 References

This document is prepared with respect to IEEE 29148-2011 standard:

29148-2011 - ISO/IEC/IEEE International Standard - Systems and software engineering – Life cycle processes –Requirements engineering.

[1] P. Alves-Oliveira, P. Arriaga, G. Hoffman, A. Paiva, Guide to build YOLO, a creativity-stimulating robot for children, HarwardX 6 2019.e00074, <http://www.elsevier.com/locate/ohx>

[2] P. Alves-Oliveira, P. Arriaga, A. Chandak, G. Hoffman, A. Paiva, Software architecture for YOLO, a creativity-stimulating robot, HarwardX 6 2020.100461, <http://www.elsevier.com/locate/softx>

3 Specific Requirements

3.1 External Interfaces

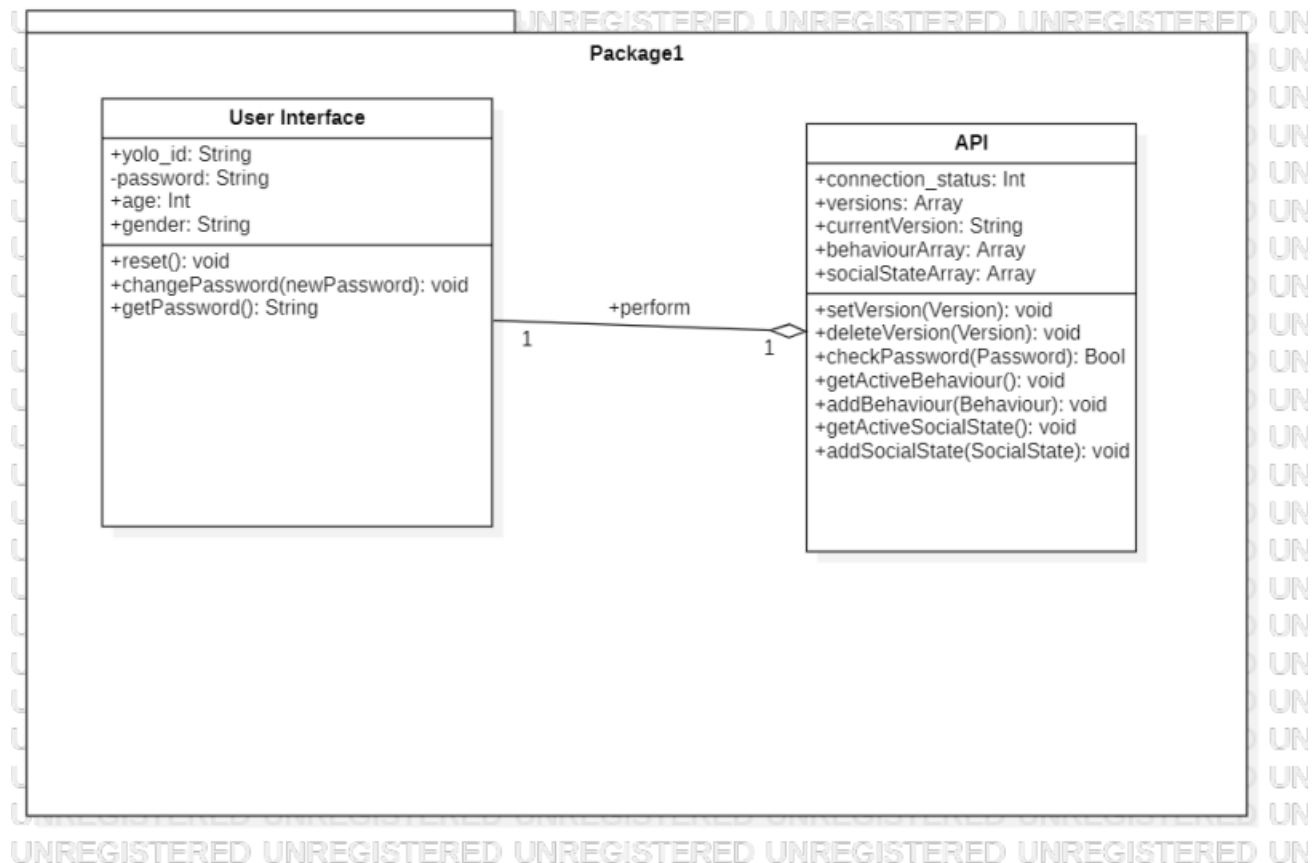


Figure 1: External entities diagram

3.2 Functions

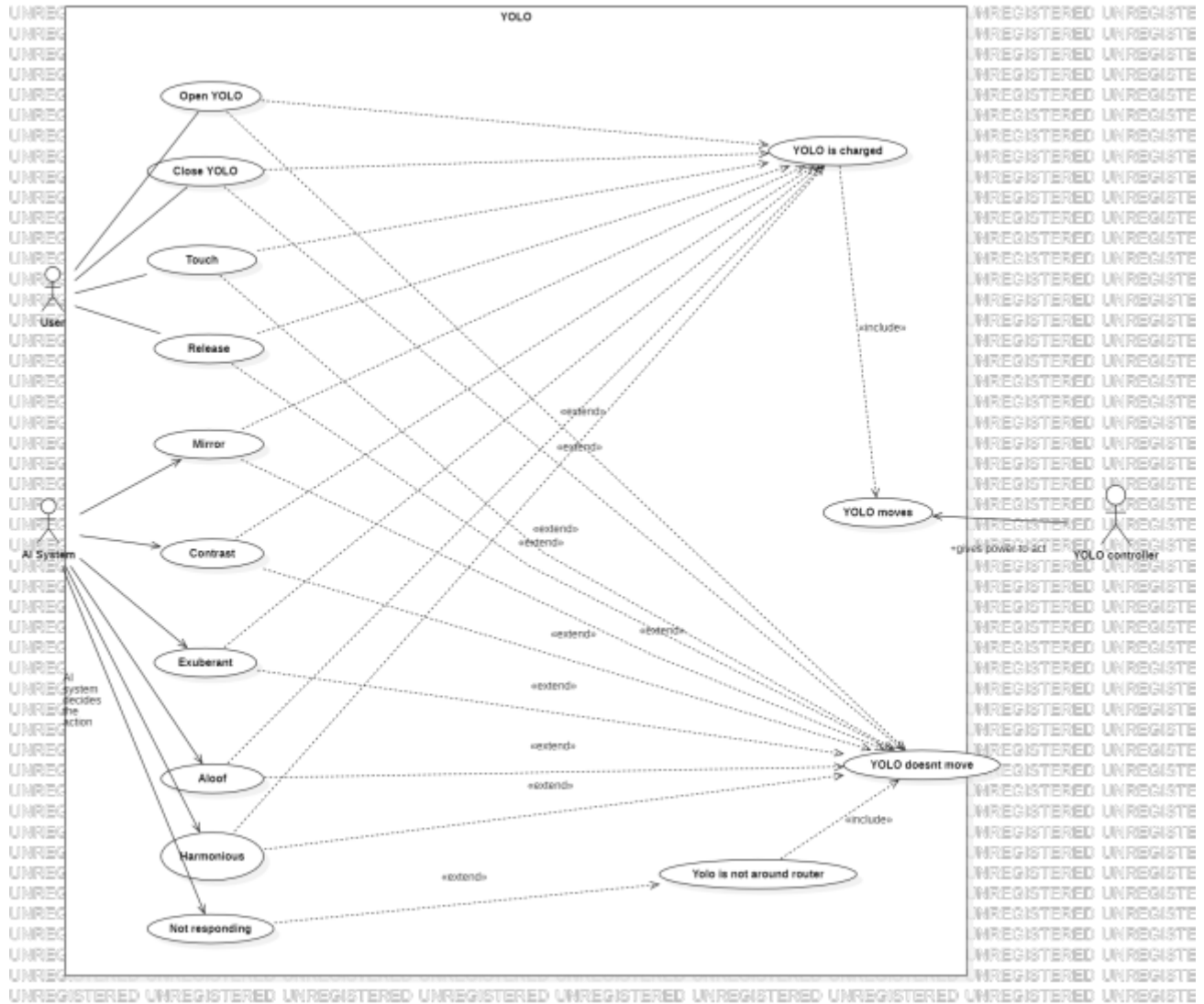


Figure 2: Use-case-diagram

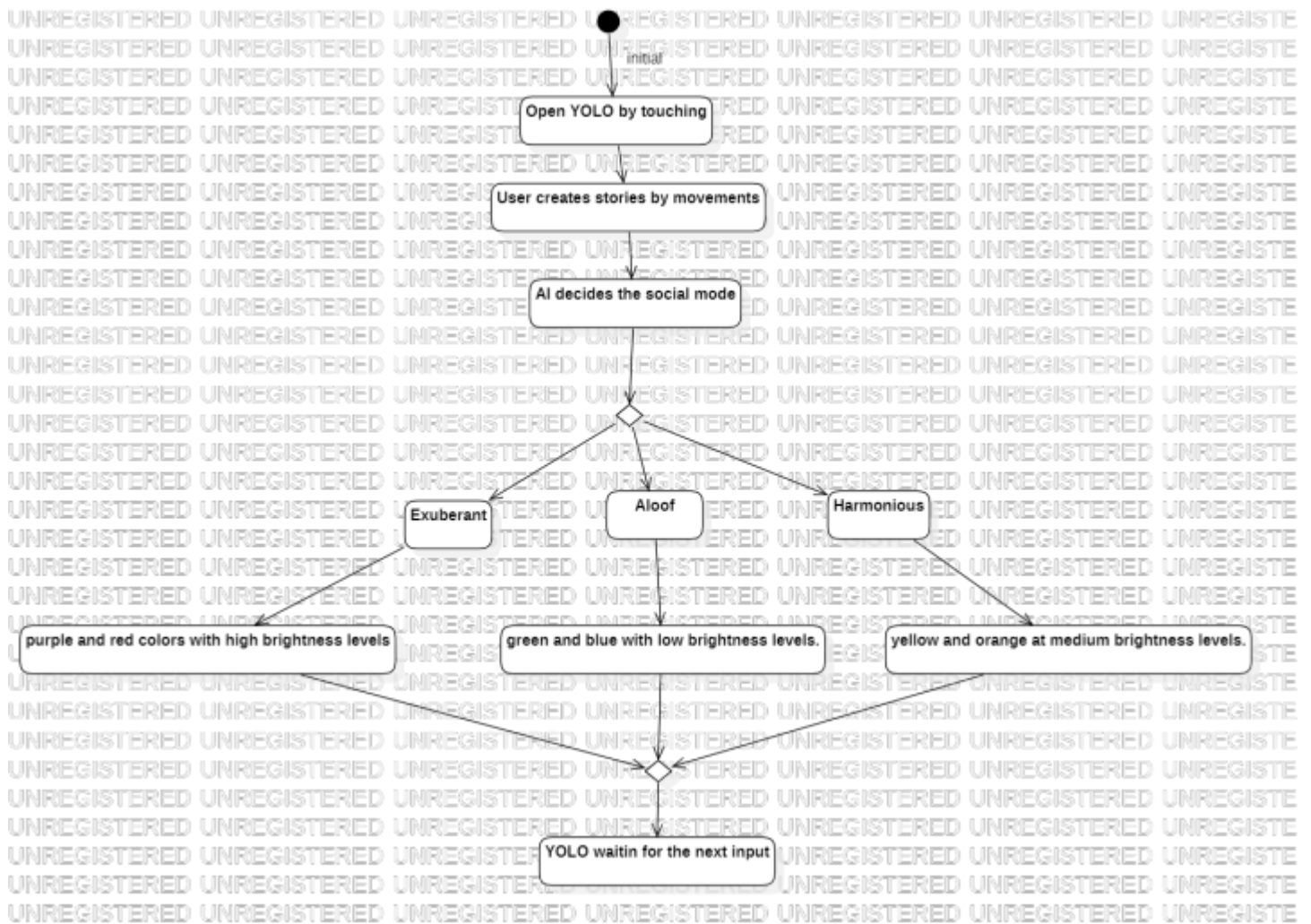


Figure 2: Activity diagram

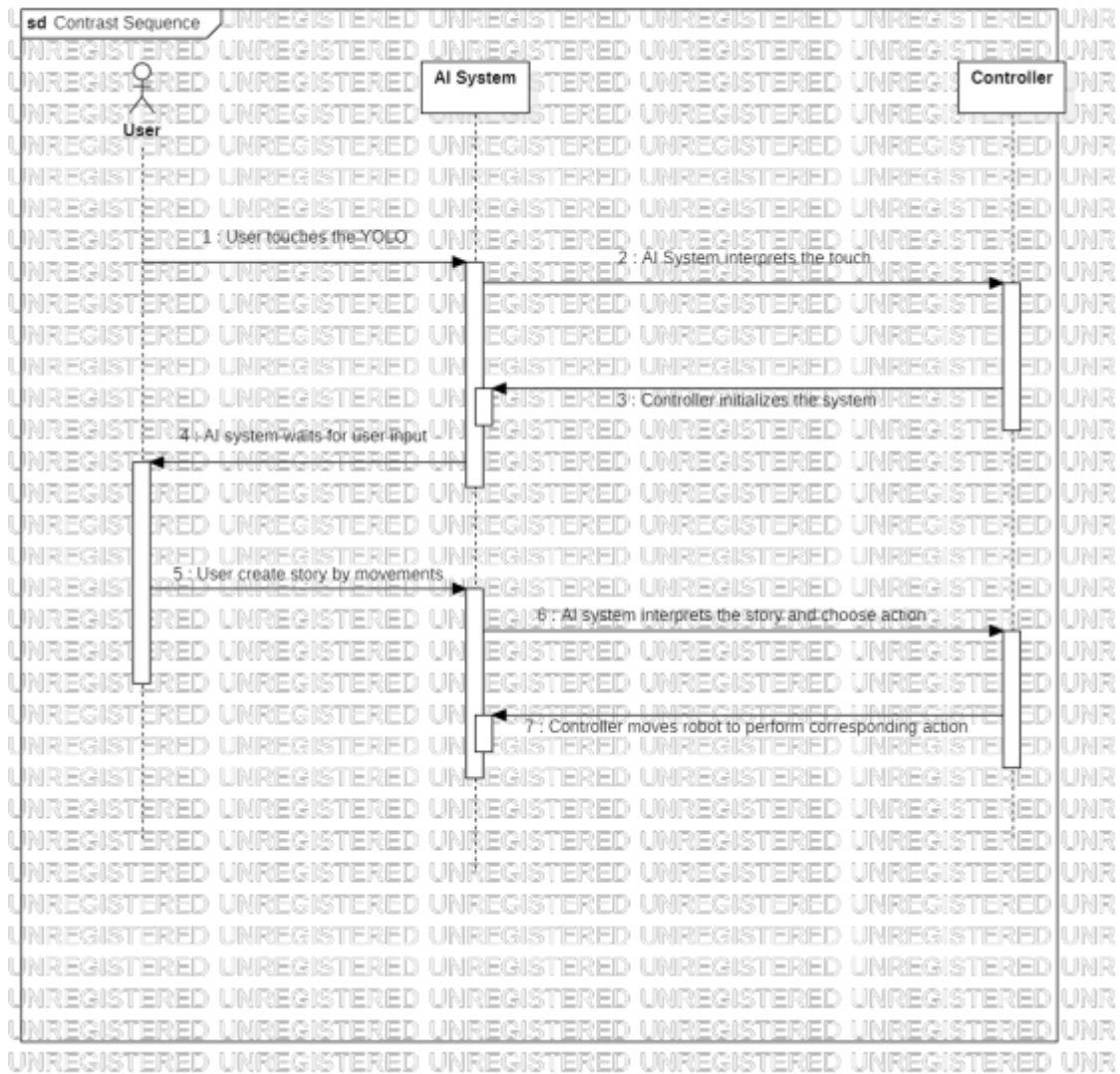


Figure 3: Sequence diagram of “Contrast Action”

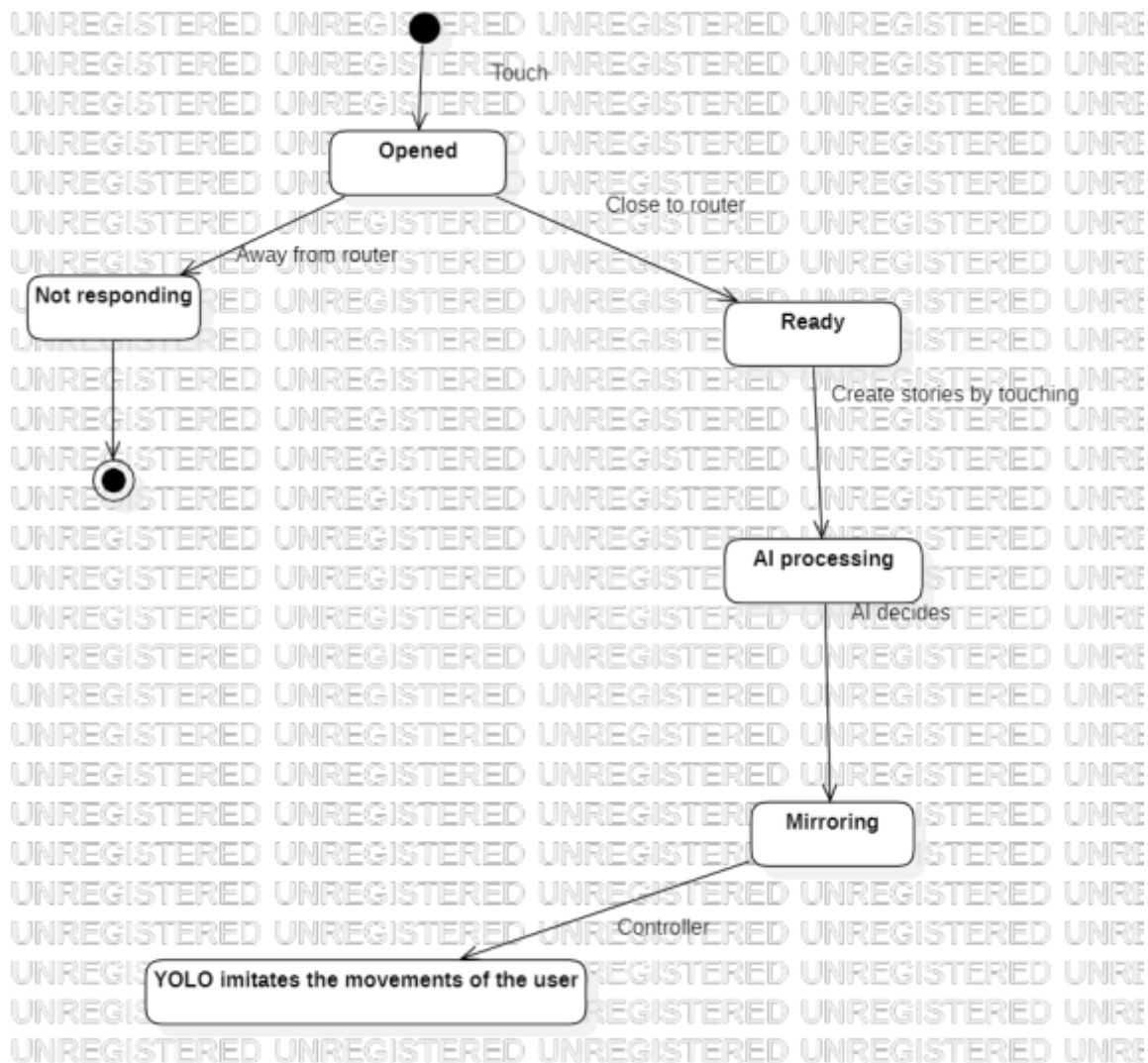


Figure 4: State diagram of “Mirroring Action”

Use case name	Launching YOLO
Actors	User, Yolo
Description	When a customer touches the YOLO, device is started and ready to take input from environment.
Data	User input
Preconditions	Yolo must be charged enough to take action.
Stimulus	User touches the YOLO
Basic Flow	<p>Step 1: User takes the Yolo and puts it on the place where he wants to play with it</p> <p>Step 2: User gets ready to play.</p> <p>Step 3: User touches the YOLO to start the Yolo.</p> <p>Step 4:Yolo starts to work</p>
Alternative Flow	-
Exception Flow	<p>Step 4: Charge isn't enough to start the machine</p> <p>Step 5: User charges the Yolo</p>
Postconditions	System is ready to take input from the YOLO.

Table 3: Launching YOLO

Use case name	Shutting down YOLO
Actors	User, YOLO
Description	User stops touching YOLO for a while. YOLO stops and does not perform anything.
Data	Not touching the robot
Preconditions	-
Stimulus	Not touching the robot
Basic Flow	Step 1: User is ready to close the YOLO Step 2: User does not touch YOLO for a while Step 3: YOLO is shut down
Alternative Flow	-
Exception Flow	Step 4: If any electrical error occurs, the device doesn't shut down
Post Conditions	Yolo can not take any inputs from the environment from now on, because it is shut down earlier.

Table 4: Shutting down YOLO

Use case name	User grabbing the YOLO
Actors	User, YOLO
Description	User grabs the YOLO in order it to follow the movements that user dictates. When user grabs the YOLO, s/he has full control of device meaning that device doesn't try to move on its own
Data	Pressure sensor understand the grabbing action
Preconditions	Device must be launched, it should have enough charge to take action, sensors must be available to take input.
Stimulus	User grabs the YOLO
Basic Flow	Step 1: User approaches the YOLO Step 2: User grabs the YOLO Step 3: User moves YOLO around the surface Step 4: YOLO doesn't act on its own
Alternative Flow	-
Exception Flow	Step 4: YOLO misunderstand the grabbing action Step 5: YOLO tries to act on its own.
Postconditions	User is free to move the device anywhere s/he wants.

Table 5: User grabbing the YOLO

Use case name	Release the YOLO
Actors	User, YOLO
Description	After grabbing the device, user decided to release the device on the desired position.
Data	Pressure sensors doesn't get input from the user anymore.
Preconditions	Device must be charged, device must be grabbed before.
Stimulus	User stops grabbing the YOLO
Basic Flow	<p>Step 1: User reaches the position where s/he wants to release the device</p> <p>Step 2: User releases the device</p> <p>Step 3: YOLO understands the releasing action.</p> <p>Step 4: YOLO stops moving</p> <p>Step 5: YOLO's AI system decides the following action.</p>
Alternative Flow	-
Exception Flow	<p>Step 5: Device doesn't understand the releasing action</p> <p>Step 6: Because of incorrect input, device still stands still and doesn't take action.</p>
Postconditions	YOLO's AI system is in charge now.

Table 6: Release the YOLO

Use case name	AI system is mirroring the action
Actors	User, YOLO AI SYSTEM
Description	Depending on the past movement input of the user such that if user grabs the device and moves it along the straight line when user release the device, YOLO's AI SYSTEM take mirroring action
Data	Past input
Preconditions	Device must be charges and device must be recently released.
Stimulus	Device takes mirroring action and moves accordingly
Basic Flow	Step 1 – User releases the device Step 2 – YOLO AI SYSTEM decides the action according to the past input Step 3 – YOLO AI SYSTEM chooses mirroring action Step 4 – YOLO AI SYSTEM follows the same straight line that user just followed by grabbing the device.
Alternative Flow	Step 4: Device misunderstood the user's path. Step 5: Device takes the contrast action.
Postconditions	Device now in the position that AI SYSTEM chooses to follow.

Table 7: AI system is mirroring the action

Use case name	Device takes contrast action
Actors	Device, AI SYSTEM
Description	Depending on the past movement input of the user such that if user grabs the device and moves it along the straight line when user release the device, YOLO's AI SYSTEM take contrast action
Data	Past input
Preconditions	Device must be charged and released recently.
Stimulus	
Basic Flow	<p>Step 1 – User releases the device</p> <p>Step 2 – YOLO AI SYSTEM decides the action according to the past input</p> <p>Step 3 – YOLO AI SYSTEM chooses contrast</p> <p>Step 4 – YOLO AI SYSTEM follows the random zig-zag line that user just followed by grabbing the device.</p>
Alternative Flow	-
Exception Flow	<p>Step 4: Device misunderstood the user's path.</p> <p>Step 5: Device takes the mirroring action.</p>
Postconditions	Device now in the position that AI SYSTEM chooses to follow.

Table 8: AI system is mirroring the action

Use case name	YOLO chooses Exuberant social mode
Actors	YOLO, Controller, AI System
Description	YOLO's AI System decides to choose Exuberant social mode with the effect of environment such as user. Controller system displays vibrant purple and red colors with high brightness levels.
Data	Environment
Preconditions	YOLO must be charged and launched.
Stimulus	Device chooses Exuberant social mode
Basic Flow	<p>Step 1 – User is playing with the YOLO</p> <p>Step 2 - YOLO's AI System interprets the user's story</p> <p>Step 3 – YOLO's AI System chooses Exuberant social mode</p> <p>Step 4 – Controller system displays vibrant purple and red colors with high brightness levels</p>
Alternative Flow	-
Exception Flow	Step 3 – YOLO's led lights' connection to the controller (or AI System) is misplaced so they do not turn on.
Postconditions	YOLO's AI System is in charge and it will decide the next action.

Table 9: YOLO chooses Exuberant social mode

Use case name	YOLO chooses Aloof social mode
Actors	YOLO, Controller, AI System
Description	YOLO's AI System decides to choose Aloof social mode with the effect of environment such as user. Controller system displays cold colors such as green and blue with low brightness levels
Data	Environment
Preconditions	YOLO must be charged and launched.
Stimulus	Device chooses Exuberant social mode
Basic Flow	Step 1 – User is playing with the YOLO Step 2 - YOLO's AI System interprets the user's story Step 3 – YOLO's AI System chooses Aloof social mode Step 4 - Controller system displays cold colors such as green and blue with low brightness levels
Alternative Flow	-
Exception Flow	Step 3 – YOLO's led lights' connection to the controller (or AI System) is misplaced so they do not turn on.
Postconditions	YOLO's AI System is in charge and it will decide the next action.

Table 10: YOLO chooses Aloof social mode

Use case name	YOLO chooses Harmonious social mode
Actors	YOLO, Controller, AI System
Description	YOLO's AI System decides to choose Harmonious social mode with the effect of environment such as user. Controller system displays warm colors such as yellow and orange at medium brightness levels.
Data	Environment
Preconditions	YOLO must be charged and launched.
Stimulus	Device chooses Harmonious social mode
Basic Flow	<p>Step 1 – User is playing with the YOLO</p> <p>Step 2 - YOLO's AI System interprets the user's story</p> <p>Step 3 – YOLO's AI System chooses Harmonious social mode</p> <p>Step 4 - Controller system displays warm colors such as yellow and orange at medium brightness levels.</p>
Alternative Flow	-
Exception Flow	Step 3 – YOLO's led lights' connection to the controller (or AI System) is misplaced so they do not turn on.
Postconditions	YOLO's AI System is in charge and it will decide the next action.

Table 11: YOLO chooses Aloof social mode

Use case name	YOLO does not respond
Actors	YOLO, Router, (User)
Description	YOLO does not respond or does nothing due to the weakened connection between the router and YOLO.
Data	-
Preconditions	YOLO is far away from the router.
Stimulus	YOLO gets out of the router's range.
Basic Flow	Step 1: User is takes the YOLO and gets it out of the router's range Step 2: YOLO is not able to connect to the router Step 3: YOLO has become unresponsive
Alternative Flow	-
Exception Flow	Step 4: YOLO is placed within the router's range Step 5: YOLO is responsive
Postconditions	YOLO does not function.

Table 12: YOLO not responding

3.3 Usability Requirements

- Users shall be able to open the YOLO by touching it.
- Users shall be able to influence the YOLO appropriate to their stories.
- Users shall be able to make YOLO take mirroring or contrast action depending on their input.
- Developers shall be able to improve or add new functionalities by personalizing the code of the YOLO.

3.4 Performance Requirements

- The YOLO's AI system should be able to correctly interpret the user's movement input.
- The YOLO's controller should be able to perform decided action.
- The YOLO should be able to be continuously active between approximately 7-8 hours.
- The YOLO's AI system should be able to correctly interpret the user's story and choose the right social behavior.
- The YOLO's controller should be able to perform decided social behavior.

3.5 Logical Database Requirements

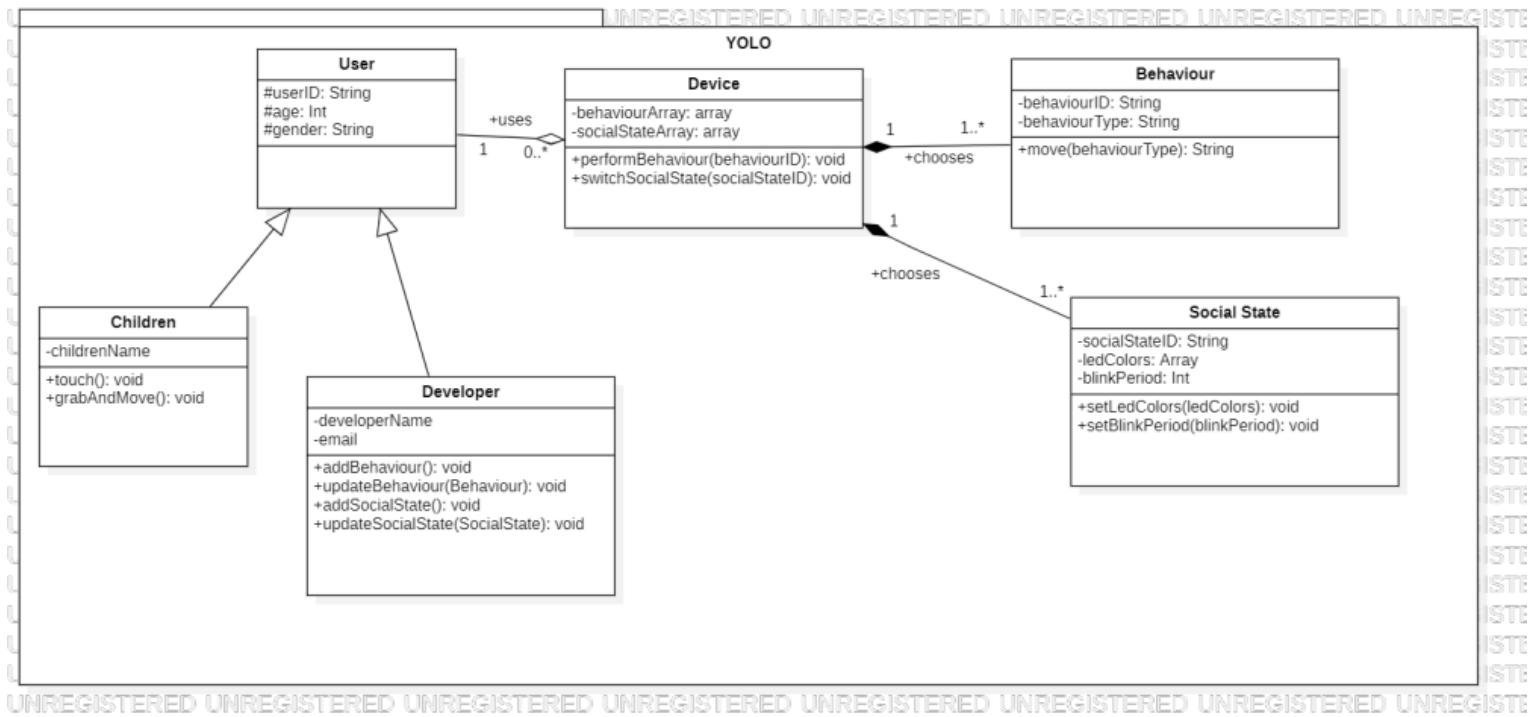


Table 13: Logical Database Diagram

3.6 Design Constraints

While creating YOLO, the experiments that involves humans are conducted in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). Consent of the subjects were obtained for experimentation with human subjects. The privacy rights of human subjects were always considered.

3.7 System Attributes

a) Reliability

- Failure count of the system's hardware components should be less than 5 in a month.
- Data loss in sensors information rate should be less than 0.01.
- Choosing incorrect social state rate should be less than 0.05

b) Availability:

- YOLO should always be available if charged.
- If YOLO is personalized by a developer, it should be ready to use less than 2 minutes.

c) Security:

- All the sensor data should be encrypted in order to protect users' data.
- Whenever a new functionality added by a developer, it should be tested for preventing undesired behavior of the YOLO.

3.1 Supporting Information

- During the development of YOLO, children were the essential part of the project. The feedback of the children shaped the core of the project.

4 Suggestions to Improve the Existing System

The core needed part of this system which can make user experience much more realistic is voice. For example, YOLO can respond to user actions with appropriate voices such that arranging frequency and decibel.

YOLO should have a face to make itself more like a real creature rather than an object. This can help user to create stories with like real characters.