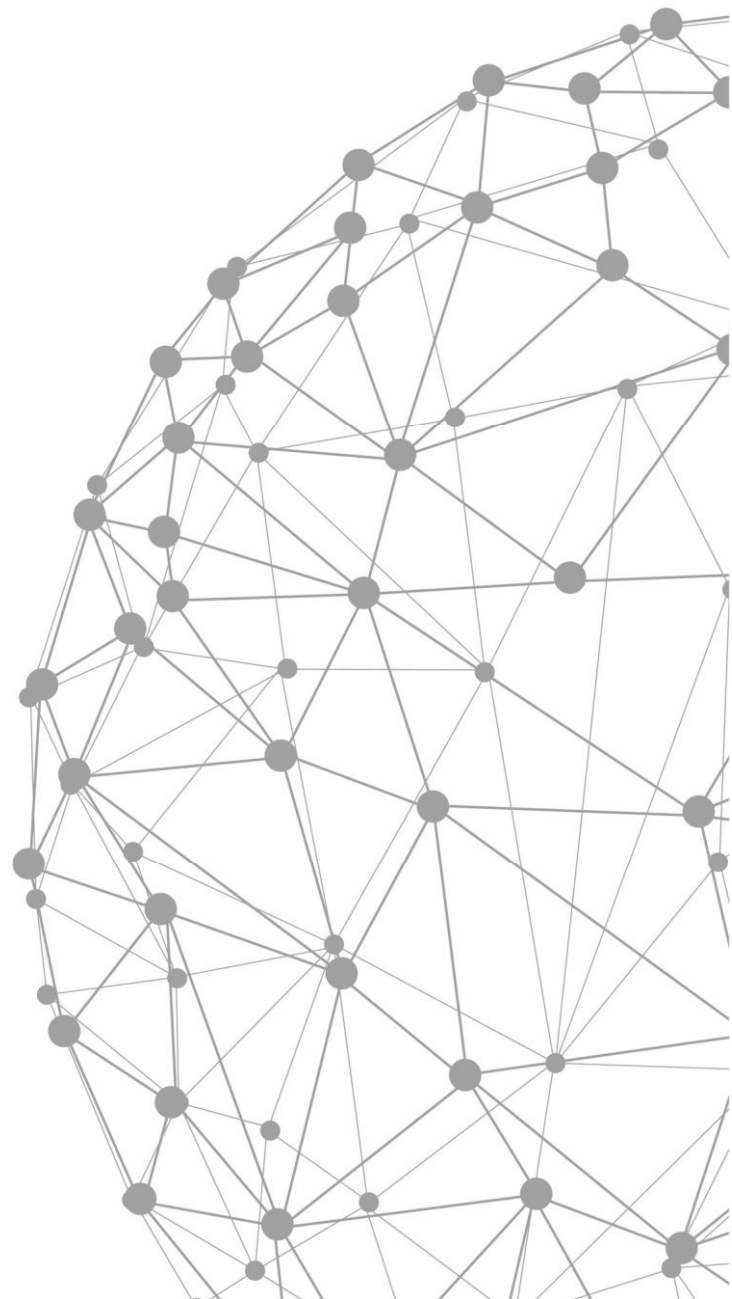

Project task 1

Pololu Zumo 32U4

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Customer:
NewTec
Development
Buchenweg 3
89284 Pfaffenhofen a. d. Roth
Germany

Author:
Team: ~~ o=o\
Hs Offenburg



Change History

Doc.-Version	Description of Modification	Date
A1	Initial revision	
A2	First version of use case diagrams, use case descriptions and requirements written	20.03.24
A3	Use case diagrams, use case descriptions and requirements modified	27.03.24

Release

	Name	Responsibility	Date	Signature
Creation				i.A.
Verification				i.A.
Approval				i.A.
Release				i.A.

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1 General

1.1 Scope of Document

1.2 Abbreviations

Abbreviation	Description
N/A	Not applicable

Table 1: Abbreviations

1.3 Terminology




Term 	Description
Robot	Zumo32U4
OLED	organic light emitting diode
OLED-display	display on the robot
StartButton	button on the robot, accessible for input
Speaker	buzzer on the robot
Redetect	
Power-On	
Short Beep	signal of frequency 440Hz, duration 100ms 
Alarm Signal	signal of frequency 440Hz, duration 200ms, repeated thrice 

Table 2: Terminology

1.4 Referenced Documents

Reference	Document-Identification	Description
[1]	N/A	N/A
	N/A	N/A

Table 3: Referenced Documents

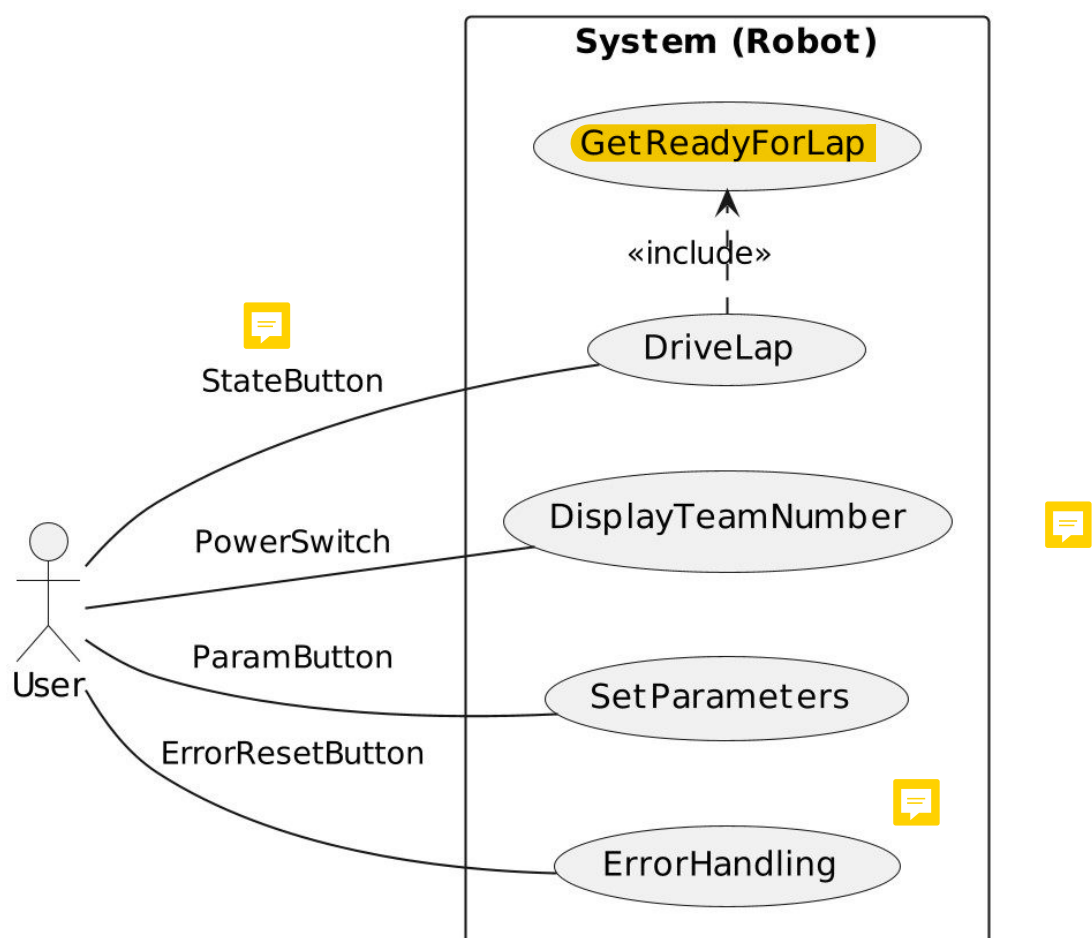
1.5 Applicable Standards

Reference	Document-Identification	Description
[1]	N/A	N/A
	N/A	N/A

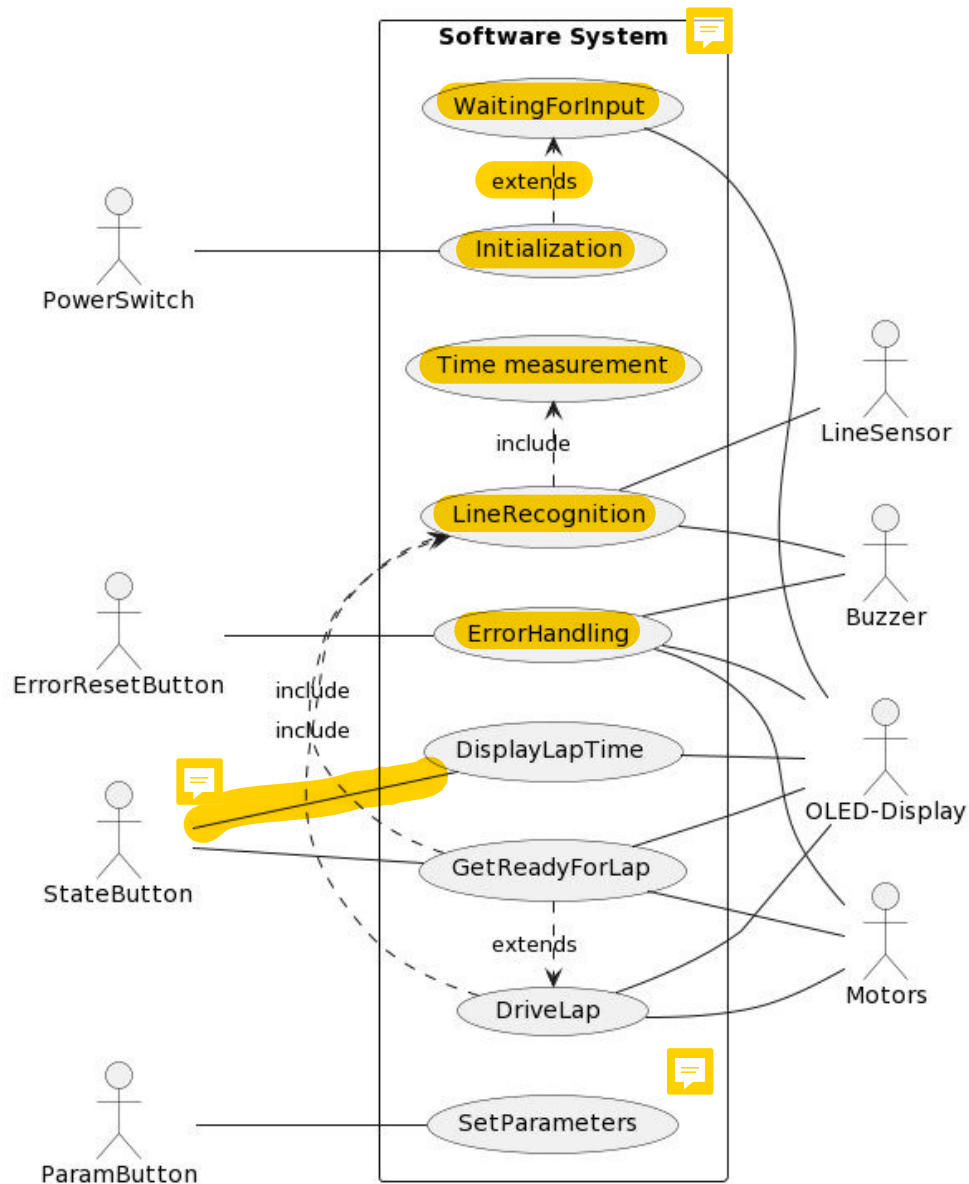
Table 4: Applicable Standards

2 Introduction

2.1 System Overview






2.2 Interface Overview




2.3 Scenarios

2.3.1 System

Reference number	2.3.1.1
Name	<i>GetReadyForLap</i>
Short description	The robot shows a count down from 3s to 0s and then starts driving.
Precondition	No other scenario is active
Postcondition	The robot recognizes the <i>StartFinishLine</i> 
Error case	The <i>StartFinishLine</i> is not recognizes after 5s
Actors	<i>User</i>
Trigger	The <i>StateButton</i> has been pressed
Standard sequence	<ul style="list-style-type: none"> The robot shows a count down from 3s to 0s on the <i>OledDisplay</i>  The robot begins driving The robot recognizes the <i>StartFinishLine</i>, immediately plays a <i>ShortBeep</i> on the <i>Buzzer</i> and switches to the state <i>DriveLap</i>
Alternative sequences	none

Reference number	2.3.1.2
Name	<i>DriveLap</i>
Short description	The robot drives one lap as fast as possible
Precondition	The <i>state</i> <i>GetReadyForLap</i> is finished 
Postcondition	The <i>StartFinishLine</i> is recognized and the robot has stopped
Error case	The <i>StartFinishLine</i> is not recognized after 20s
Actors	<i>none</i>
Trigger	The <i>state</i> <i>GetReadyForLap</i> is finished
Standard sequence	<ul style="list-style-type: none"> The <i>state</i> <i>GetReadyForLap</i> is finished The robot continues driving for one lap The robot recognizes the <i>StartFinishLine</i> and stops
Alternative sequences	none

Reference number	2.3.1.3
Name	<i>DisplayTeamNumber</i>
Short description	The <i>TeamNumber</i> is shown on the <i>OledDisplay</i>
Precondition	No other scenario is active 
Postcondition	The <i>TeamNumber</i> is still being displayed
Error case	none
Actors	<i>User</i>
Trigger	<i>PowerSwitch</i> is turned on
Standard sequence	<ul style="list-style-type: none"> The <i>PowerSwitch</i> is turned on The <i>TeamNumber</i> is shown on the <i>OledDisplay</i> (Only user input or an error ends this state)
Alternative sequences	none

Reference number	2.3.1.4
Name	<i>SetParameters</i>
Short description	Allows individual parameters to be adjusted
Precondition	Robot is in state <i>DisplayTeamNumber</i>
Postcondition	Robot goes to state <i>DisplayTeamNumber</i>
Error case	none
Actors	<i>User</i>
Trigger	The <i>ParamButton</i> is pressed
Standard sequence	<ul style="list-style-type: none"> Robot is in state <i>DisplayTeamNumber</i> and the <i>ParamButton</i> is pressed Shows the variables to be set on the display and allows them to be adjusted The robot goes back to the state <i>DisplayTeamNumber</i>
Alternative sequences	none

Reference number	2.3.1.5
Name	<i>ErrorHandling</i>
Short description	Displays an error message until the user resets it
Precondition	An error occurred
Postcondition	Robot goes to state <i>DisplayTeamNumber</i>
Error case	none
Actors	<i>User</i>
Trigger	An error occurs
Standard sequence	<ul style="list-style-type: none"> • An error occurs • The robot stops immediately • The <i>AlarmSignal</i> is played on the <i>Buzzer</i> • An error message is displayed on the <i>OledDisplay</i> • The User resets the state to <i>DisplayTeamNumber</i> via the <i>ErrorResetButton</i>
Alternative sequences	none

2.3.2 Interface



Reference number	2.3.2.1
Name	<i>Initialization</i>
Short description	During this step, all required features and variables are initialized
Precondition	Robot is switched off, hardware reset button or <i>ErrorReset</i> has been pressed
Postcondition	All variables must be initialized and the robot is ready for input
Error case	Jump to <i>ErrorHandling</i> and output the corresponding error code
Actors	<i>PowerSwitch</i>
Trigger	<i>PowerSwitch</i> , <i>ErrorReset</i> if the robot is in <i>ErrorHandling</i> and Hardware reset button
Standard sequence	All required system features such as memory, GPIO, timer, variables, etc. are initialized
Alternative sequences	none

Reference number	2.3.2.2
Name	<i>WaitingForInput</i>
Short description	The robot is initialized and waits for input from the user, while he is waiting the team name is displayed
Precondition	The initialization must be completed
Postcondition	User must have made an input and depending on this the robot behaves accordingly
Error case	Jump to <i>ErrorHandling</i> and output the corresponding error code
Actors	<i>OLED-Display</i>
Trigger	Initialization has been successfully completed
Standard sequence	The team name is shown on the OLED display until input is received from the user
Alternative sequences	none

Reference number	2.3.2.3
Name	<i>GetReadyForLap</i>
Short description	The robot starts with a count down from 3 to 0 and then starts moving.
Precondition	The robot must be in <i>WaitingForInput</i>
Postcondition	Robot must travel as fast as possible
Error case	Jump to <i>ErrorHandling</i> and output the corresponding error code
Actors	<i>OLED-Display, Motors</i>
Trigger	The StateButton has been pressed
Standard sequence	The robot starts a count down from 3 to 0 which is shown on the display. The robot then moves off until it just passes the start/finish line
Alternative sequences	none

Reference number	2.3.2.4
Name	<i>DriveLap</i>
Short description	The robot drives the fastest possible lap
Precondition	The robot must cross the start/finish line in <i>GetReadyForLap</i>
Postcondition	The robot must stop
Error case	Jump to <i>ErrorHandling</i> and output the corresponding error code
Actors	<i>OLED-Display, Motors</i>
Trigger	The robot has crossed the start/finish line in <i>GetReadyForLap</i>
Standard sequence	The robot drives the fastest possible lap around the given course
Alternative sequences	none

Reference number	2.3.2.5
Name	<i>LineRecognition</i>
Short description	It recognizes where the guideline is and whether the start/finish line has been crossed
Precondition	Initialization is finished
Postcondition	none
Error case	Jump to <i>ErrorHandling</i> and output the corresponding error code
Actors	<i>LineSensor, Buzzer</i>
Trigger	Robot is either in <i>GetReadyForLap</i> or in <i>DriveLap</i>
Standard sequence	It recognizes where the guideline is and every time the start/finish line is crossed, the <i>buzzer</i> is activated
Alternative sequences	none

Reference number	2.3.2.6
Name	<i>TimeMeasurement</i>
Short description	Measures the time of a lap
Precondition	Robot must cross the start/finish line while it is in <i>GetReadyForLap</i>
Postcondition	Timer must be stopped
Error case	Jump to <i>ErrorHandling</i> and output the corresponding error code
Actors	none
Trigger	The timer is triggered by crossing the start/finish line in <i>GetReadyForLap</i>
Standard sequence	The timer is started by crossing the start/finish line in <i>GetReadyForLap</i> and is stopped as soon as the start/finish line is crossed again
Alternative sequences	none

Reference number	2.3.2.7
Name	<i>DisplayLapTime</i>
Short description	Displays the completed lap time
Precondition	One round must have been successfully completed
Postcondition	Time is no longer displayed
Error case	Jump to <i>ErrorHandling</i> and output the corresponding error code
Actors	<i>OLED-Display, StateButton</i>
Trigger	Start/finish line was crossed in <i>DriveLap</i>
Standard sequence	The completed lap time is displayed
Alternative sequences	none

Reference number	2.3.2.8
Name	<i>ErrorHandling</i>
Short description	Displays an error message
Precondition	The program must have thrown an error during its runtime
Postcondition	New initialization of the program
Error case	none
Actors	<i>OLED-Display, Buzzer, Motors</i>
Trigger	An error has occurred in the program
Standard sequence	The robot must stop immediately, a warning tone is emitted via the buzzer and an error message is shown on the display
Alternative sequences	none

Reference number	2.3.2.9
Name	<i>SetParameters</i>
Short description	Allows individual parameters to be adjusted during runtime
Precondition	Robot must be in <i>WaitingForInputs</i> or <i>DisplayLapTime</i>
Postcondition	Robot is in <i>WaitingForInput</i>
Error case	Jump to <i>ErrorHandling</i> and output the corresponding error code
Actors	<i>OLED-Display, ParamButton</i>
Trigger	The ParamButton button has been pressed
Standard sequence	Shows the variables to be set on the display and allows them to be adjusted
Alternative sequences	none

3 Requirements

3.1 Functional Requirements

The Robot shall start driving 3s after the operator presses the StartButton.

If the Robot detects the start line the Robot shall do ALL of the following steps

- emit a short beep via Buzzer
- start the time measurement for the lap

If the Robot detects the end line the Robot shall do ALL of the following steps

- stop any motion
- emit a short beep via Buzzer
- end the time measurement for the lap
- display the measured time for the lap on the OLED-Display

The Robot shall complete one lap in 20s or less otherwise the Robot shall detect an error

If the Robot leaves the track, the robot shall Redetect the track in 5s or less otherwise the Robot shall detect an error

The Robot shall run during daytime- or office light conditions

If the Robot detects an error the Robot shall do the following steps in order

- stop any motion
- emit an alarm signal via Buzzer
- display the error reason on the OLED

After Power-On the Robot shall display the team-number on the OLED-display for at least 2s



3.2 Non-Functional Requirements

The software shall be hardware independent

The programmer shall write the software in the programming language C

During the competition the only changes to the software shall be the selection of a predefined list of parameters

The software shall at most use 80% of the available flash memory

4 Interface

4.1 External Interfaces

5 Document Management

5.1 Document Creation

6 Appendix