Joint Project AIS/ML (Master IT)

Up to 10 groups of 4 persons

Project supervisors: Prof. A. Pech / Prof. P. Nauth
Project coordinator: Mr. J. Umansky

Prj.	Task	Milestone	Date
1	**Parameter setting and reliability test of a sensor system for <u>person detection in a car</u> wearing summer wear.**		
	a) Introduction: Getting familiar with the measurement equipment and the measuring methods. Measurement equipment provided.	**<u>MS1</u>: Introduction completed**	**29-Oct 2021**
	b) Measurement data collection using summerwear (= data set #1 consisting of at least 1000 events of getting into the car, staying seated for 2 seconds and subsequently getting out of the car thus creating at least 40000 measurement scans). Record the experimental setup properly including all environmental conditions and photos of the clothing. At least 10 different persons with varying outfits and sizes. Record the size of the persons involved for each measurement. Take photos of the clothing used. The classification result of the sensor will be stored automatically. Submit data set.	**<u>MS2</u>: Data set #1 sbm.**	**20 - Nov 2021**
	c) Evaluation of data set #1: Create a confusion matrix of the classification results of data set #1.	**<u>MS3</u>: Confusion matrix sbm.**	**27-Nov 2021**
	d) Adjust the thresholds of feature #1 and feature #10 in order to get a higher TPR (true positive rate) and lower FPR (false negative rate). After threshold adjustment, record again at least 40000 measurement scans. Take measurements using the same clothing, same persons and variations as used in task a). Create a confusion matrix. Submit data set #2 and the confusion matrix of dataset #2.	**<u>MS4</u>: Data set #2 & confusion matrix sbm.**	**18-Dec 2021**
	e) Conduct a test of the system when the engine of the car is running; at least 40000 measurement scans forming data set #3. Variations as in subtask a). Submit data set #3 and the confusion matrix.	**<u>MS5</u>: Data set #3 & confusion matrix sbm.**	**04-Feb 2022**
	f) Adjust the thresholds for feature #1 and feature #10 for the running car. Take at least 40000 measurement scans for data set #4. Create a confusion matrix.	**<u>MS6</u>: Data set #4 & confusion matrix sbm.**	**07 - Mar 2022**
	g) Research on and implementation of improvements such as: - Vary systematically the lateral/vertical seat position and/or the angle of incident of the sonic waves and/or the distance, take additional measurements and compare the results. Submit the measuring data and the result.	**<u>MS7</u>: Research & Improvem. finished**	**18 - Mar 2022**

	- Improve the mounting of the sensor in order to improve stability, reproducibility and systematic variations of angle of incidences. - Take measurements of various objects including a dressed dummy and compare the results. Submit the measuring data. - Develop and implement feature extraction and classification SW software for analysis of the recoded data sets. Reason the algorithms chosen based on your evaluations of the data sets. -Analyse systematically results, data and FFTs especially of false predictions and give reasons, e.g. based on research scientific papers and books and on ultrasonic physics.		
	h) Write a report and submit it. Report should contain theory, HW, SW (if applicable), data processing, measurement settings and variations, results and photos. It also should explain briefly the context of the project to the module.	**MS8: Report sbm.**	**31-Mar 2022**
	i) Give a demonstration of your system. Demonstration date to be announced.	**MS9: Demonstr.**	**tba**

Grading: Tasks a) – h) are required to pass the module. Additional achievements such as tasks as of i) improve the grade. Comprehensible result description, stable and reproducible measurement settings, systematically variations of boundary conditions, a clearly structured report and research of scientific papers about state of the art (SOTA) also contribute to the grade.

Prj.	Task	Milestone	Date
2	**Parameter setting and reliability test of a sensor system for <u>person detection in a car</u> wearing winter wear.**		
	a) Introduction: Getting familiar with the measurement equipment and the measuring methods. Measurement equipment provided.	**<u>MS1</u>: Introduction completed**	**29-Oct 2021**
	b) Measurement data collection using winterwear (= data set #1 consisting of at least 1000 events of getting into the car, staying seated for 2 seconds and subsequently getting out of the car thus creating at least 40000 measurement scans). Record the experimental setup properly including all environmental conditions and photos of the clothing. At least 10 different persons with varying outfits and sizes. Record the size of the persons involved for each measurement. Take photos of the clothing used. The classification result of the sensor will be stored automatically. Submit data set.	**<u>MS2</u>: Data set #1 sbm.**	**20 - Nov 2021**
	c) Evaluation of data set #1: Create a confusion matrix of the classification results of data set #1.	**<u>MS3</u>: Confusion matrix sbm.**	**27-Nov 2021**
	d) Adjust the thresholds of feature #1 and feature #10 in order to get a higher TPR (true positive rate) and lower FPR (false negative rate). After threshold adjustment, record again at least 40000 measurement scans. Take measurements using the same clothing, same persons and variations as used in task a). Create a confusion matrix. Submit data set #2 and the confusion matrix of dataset #2.	**<u>MS4</u>: Data set #2 & confusion matrix sbm.**	**18-Dec 2021**
	e) Conduct a test of the system when the engine of the car is running; at least 40000 measurement scans forming data set #3. Variations as in subtask a). Submit data set #3 and the confusion matrix.	**<u>MS5</u>: Data set #3 & confusion matrix sbm.**	**04-Feb 2022**
	f) Adjust the thresholds for feature #1 and feature #10 for the running car. Take at least 40000 measurement scans for data set #4. Create a confusion matrix.	**<u>MS6</u>: Data set #4 & confusion matrix sbm.**	**07 - Mar 2022**
	g) Research on and implementation of improvements such as: - Vary systematically the lateral/vertical seat position and/or the angle of incident of the sonic waves and/or the distance, take additional measurements and compare the results. Submit the measuring data and the result. - Improve the mounting of the sensor in order to improve stability, reproducibility and systematic variations of angle of incidences. - Take measurements of various objects including a dressed dummy and compare the results. Submit the measuring data. - Develop and implement feature extraction and classification SW software for analysis of the recoded data sets. Reason the algorithms chosen based on your evaluations of the data sets.	**<u>MS7</u>: Research & Improvem. finished**	**18 - Mar 2022**

	-Analyse systematically results, data and FFTs especially of false predictions and give reasons, e.g. based on research scientific papers and books and on ultrasonic physics.		
	h) Write a report and submit it. Report should contain theory, HW, SW (if applicable), data processing, measurement settings and variations, results and photos. It also should explain briefly the context of the project to the module.	**MS8: Report sbm.**	**31-Mar 2022**
	i) Give a demonstration of your system. Demonstration date to be announced.	**MS9: Demonstr.**	**tba**

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Prj.	Task	Milestone	Date
3	**Parameter setting and reliability test of a sensor system for driver size estimation in a car.**		
	a) Induction: Getting familiar with the measurement equipment and the measuring methods. Measurement equipment provided.	**MS1**: **Introduction completed**	**29-Oct 2021**
	b) Measurement data collection (= data set #1, raw signal) consisting of at least 1000 events of persons getting onto the driver seat of a car, staying seated for 2 seconds and subsequently getting out of the car thus creating at least 40000 measurements. Record the experimental setup properly including all environmental conditions and photos of the clothing. At least 20 different persons with varying outfits. Record the size of the persons involved for each measurement. Take photos of the clothing used. The distance estimated by the sensor will be stored automatically. Submit data set #1.	**MS2: Data set #1 sbm.**	**20 - Nov 2021**
	c) Evaluation of data set #1: Compare the estimated driver's height with the manually measured height of the persons. Calculate the mean square error. Report the results.	**MS3: Confusion matrix sbm.**	**27-Nov 2021**
	d) Systematically adjust the sensor angle and position in order to get a lower mean square error of the height estimation. Report the sensor positions properly for reproduction purposes. After adjustment, repeat the measurement of subitem b (data set #2) and the evaluation as in subitem c.	**MS4: Data set #2 & confusion matrix sbm.**	**18-Dec 2021**
	e) Conduct a test of the system when the engine of the car is running, by repeating the measurements of subitem b thus creating data set #3. Evaluate the results as in subitem c. Submit data set #3 and the evaluation report.	**MS5: Data set #3 & confusion matrix sbm.**	**04-Feb 2022**
	f) Systematically adjust the sensor angle and position for the running engine in order to get a lower mean square error of the height estimation. Report the sensor positions properly for reproduction purposes. After adjustment, repeat the measurement of subitem b (data set #4) and the evaluation as in subitem c.	**MS6: Data set #4 & confusion matrix sbm.**	**07 - Mar 2022**
	g) Research on and implementation of improvements such as: - Vary the lateral seat position systematically, take additional measurements and compare the results. - Compare the reported distances of all measurements to the distances calculated from the raw signals. - Vary the sensor positions and seat positions systematically in order to find the best adjustment for measuring the distance between the sensor and the drivers forehead.	**MS7: Research & Improvem. finished**	**18 - Mar 2022**

	- Develop and implement driver distance estimation SW software for analysis of the recoded data sets. Reason the algorithms chosen based on your evaluations of the data sets. - Analyze systematically results and data especially of false predictions and give reasons, e.g. based on ultrasonic physics.		
	h) Write a report and submit it. Report should contain theory, HW, SW (if applicable), data processing, measurement settings and variations, results and photos. It also should explain briefly the context of the project to the module.	**MS8: Report sbm.**	**31-Mar 2022**
	i) Give a demonstration of your system. Demonstration date to be announced.	**MS9: Demonstr.**	**tba**

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Prj.	Task (!! Task description to be modified !!)	Milestone	Date
4	**Parameter setting and reliability test of a sensor system <u>for infant carrier car seat sensing</u> in a car**		
	a) Introduction: Getting familiar with the measurement equipment and the measuring methods. Measurement equipment provided.	**<u>MS1</u>: Introduction completed**	**29-Oct 2021**
	b) Measurement data collection using summerwear (= data set #1 consisting of at least 1000 events of infant carrier without baby and with baby thus creating at least 40000 measurement scans). Record the experimental setup properly including all environmental conditions and photos of the clothing. At least 2 different persons with varying outfits and sizes. Record the size of the babies involved for each measurement. Take photos of the clothing used. The classification result of the sensor will be stored automatically. Submit data set.	**<u>MS2</u>: Data set #1 sbm.**	**20 - Nov 2021**
	c) Evaluation of data set #1: Create a confusion matrix of the classification results of data set #1.	**<u>MS3</u>: Confusion matrix sbm.**	**27-Nov 2021**
	d) Adjust the thresholds of feature #1 and feature #10 in order to get a higher TPR (true positive rate) and lower FPR (false negative rate). After threshold adjustment, record again at least 40000 measurement scans. Take measurements using the same clothing, same babies and variations as used in task a). Create a confusion matrix. Submit data set #2 and the confusion matrix of dataset #2.	**<u>MS4</u>: Data set #2 & confusion matrix sbm.**	**18-Dec 2021**
	e) Conduct a test of the system when the engine of the car is running; at least 40000 measurement scans forming data set #3. Variations as in subtask a). Submit data set #3 and the confusion matrix.	**<u>MS5</u>: Data set #3 & confusion matrix sbm.**	**04-Feb 2022**
	f) Adjust the thresholds for feature #1 and feature #10 for the running car. Take at least 40000 measurement scans for data set #4. Create a confusion matrix.	**<u>MS6</u>: Data set #4 & confusion matrix sbm.**	**07 - Mar 2022**
	g) Research on and implementation of improvements such as: - Vary systematically the lateral/vertical seat position and/or the angle of incident of the sonic waves and/or the distance, take additional measurements and compare the results. Submit the measuring data and the result. - Improve the mounting of the sensor in order to improve stability, reproducibility and systematic variations of angle of incidences. - Take measurements of various objects including a dressed dummy and compare the results. Submit the measuring data. - Develop and implement feature extraction and classification SW software for analysis of the recoded data sets. Reason the algorithms choosen based on your evaluations of the data sets.	**<u>MS7</u>: Research & Improvem. finished**	**18 - Mar 2022**

	-Analyse systematically results, data and FFTs especially of false predictions and give reasons, e.g. based on research scientific papers and books and on ultrasonic physics.		
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	i) Give a demonstration of your system. Demonstration date to be announced.	**MS9: Demonstr.**	**tba**

Grading: Tasks a) – h) are required to pass the module. Additional achievements such as tasks as of i) improve the grade. Comprehensible result description, stable and reproducible measurement settings, systematically variations of boundary conditions, a clearly structured report and research of scientific papers about state of the art (SOTA) also contribute to the grade.

Prj.	Task (!! Task description to be modified !!)	Milestone	Date
5	**Parameter setting and reliability test of a sensor system <u>for person detection in and outside a car</u> using a sensor with <u>teach-in technology</u>.** a) Introduction: Getting familiar with the measurement equipment and the measuring methods. Measurement equipment provided. b) Execution of teach-in using winterwear (= data set #1 consisting of at least 1000 events of infant carrier without baby and with baby thus creating at least 40000 measurement scans). Record the experimental setup properly including all environmental conditions and photos of the clothing. At least 2 different persons with varying outfits and sizes. Record the size of the babies involved for each measurement. Take photos of the clothing used. The classification result of the sensor will be stored automatically. Submit data set. c) .....similar to project 2		

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