

Supervisor's Review of the Bachelor's Thesis

Thesis title: SMART SENSORS AND THEIR APPLICATION IN MONITORING
RESPIRATORY RATE / INTELIGENTNÍ SENZORY A JEJICH APLIKACE PRO
MONITOROVÁNÍ RESPIRAČNÍCH POMĚRŮ

Author's name: Wusu Sorie Nanday KAMARA

Study programme: B 3944 Biomedical Technology

Field of study: B0914P360007 Biomedical Technology

Academic year: 2019/2020

Type of thesis: Bachelor's

Thesis supervisor: prof. Ing. Jaroslav Nosek, CSc.

Evaluation Criteria of the Thesis	Evaluation 1-2-3-4
1. General description	
Quality and topicality of the theoretical knowledge	1
Ability to express own ideas and drawing conclusions	2
Professional contribution	1
2. Student's activity	
Student's extent of independence in thesis elaboration	1
Utilization of consultations with the supervisor	1
Utilization of comments and recommendations provided by the thesis supervisor	1
3. Evaluation of the practical part	
Formulating and defining the thesis aims and objectives	1
Formulating hypotheses	2
Appropriateness of chosen methods and procedures	2
4. Work with professional literature	
Quality, topicality and relevance of the sources	1
5. Formal level	
Compliance with the recommended rules and regulations of the formal layout (Methodology of elaboration of final theses)	1
Quality, justification and comprehensibility of the appendices, tables and figures	2
Language level	1

Verbal comments on the evaluation of the bachelor's thesis:

In accordance with the assignment, the student has done thorough search of current techniques used for Monitoring Respiratory Rate (MRR). Student focused on Respiratory Inductive Plethysmography (RIP), using different types of sensors. RIP is a method for monitoring respiratory rate by using a respiratory belt to which sensors are attached. The belt surroundings the thoracic region, and second one the abdomen of a human body.

In particular, student studied the possibilities of using smart materials to sense the forces / pressures caused by a change in the circumference of the chest during breathing.

Selected smart materials, especially of the ferroelectric relaxor type, show extreme values of the electromechanical coupling factor, which would enable the realization of a force / pressure sensor with exceptional sensitivity. Such an intention as an application for RIP has not yet been published.

Due to the fact that relaxor materials are currently financially unavailable, the student worked and experimentally verified the available smart materials: piezoelectric PZT ceramics, and quartz units.

The student got acquainted with the basic properties of selected smart materials and the principle of design of a force sensor in the shape of piezoceramic, or quartz plates. I consider this part very important.

The sensitivity of the piezoelectric quartz force sensor was then tested experimentally. Its piezoelectric coefficient was determined by a dynamic method. The results on the quartz of the α modification have been shown to be much better reproducible than the results on a piezoceramic disk shape sensor (although PZT-type ceramics have a higher electromechanical coupling factor).

Since the extensible force is needs for MRR sensing, a transducer of the extensible force to a low-frequency compressive force (sensed by a piezoelectric sensor) is discussed.

The student is aware of the possibility of using a *piezoresistive sensor*, which would allow direct sensing of extensional force. However, it is a completely different implementation of the sensor and the processing of the output signal.

The number of references studied by student is evidenced by the large number of references (86).

All work (study, consultation, experimental part) was affected by the situation caused by measures against the spread of coronavirus. However, in the period from May to June 2020, when the university opened, the student was already working at full capacity. I recommend the bachelor's thesis for defense.

Plagiarism check performed on Thesis.cz .

The highest similarity rate 5 %, number of similar documents 1.

Overall assessment (grading scale: excellent, very good, good, unsatisfactory/fail)	excellent
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I recommend the bachelor's thesis for defence.