

I. IDENTIFICATION DATA

Thesis title:	Roball robot.
Author's name:	Juan Gustavo Maldonado Quispe.
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Instrumentation and Control Engineering.
Thesis reviewer:	Ing. Zdeněk Novák, Ph.D.
Reviewer's department:	Department of Instrumentation and Control Engineering.

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	ordinarily challenging
<i>How demanding was the assigned project?</i>	
I evaluate the assignment as ordinarily challenging, since the topic is publicly available and there are commercial solutions of such a product, as well as published articles.	

Fulfilment of assignment	fulfilled
<i>How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.</i>	
Thesis guidelines are short, there are no strict specifications on thesis output, or how to judge the solution. Therefore, I have to rate it as fulfilled, as there is no original proposal to compare it with.	

Methodology	partially applicable
<i>Comment on the correctness of the approach and/or the solution methods.</i>	
<p>Student selected a partially correct approach how to solve the thesis topic. He started with the state of the art and then continued with the initial type of robot design. The driving mechanism is based on a selected sphere robot. It is not clear, why student started to write down equations for the driving torque without substituting any real numbers to calculate it. He stated that some model factors are ignored. However, the friction inside the sphere should not be ignored as this is the main guideline of the thesis, i.e., to design a better mechanical solution. Additionally, it is not clear, why student started to solve mechanical design (chapter 2), then continued with electronics/software design (chapter 3), and then went back to mechanical design (chapter 4.1) followed by testing. Why the chapter 4 is not only about tests? The commercial design has a wireless charging option. Is the new mechanical design better? Does it solve something in a new way? Those question should be answered in conclusions. The conclusions states "The goal was to create a robot capable of moving in all directions and self-stabilizing, while also being adaptable for future improvements". However, there are no such words in thesis guidelines. If this was the case, it would be easier to evaluate the fulfilment of the thesis assignment.</p>	

Technical level	C - good.
<i>Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?</i>	
<p>The technical part of the work is thoroughly commented by the student. In my opinion, some sentences are too unnecessarily complicated, which degrades the student's reasoning for choosing such and such a solution. Additionally, thesis would require further test to evaluate the design, especially the self-stabilizing procedure. It is not clear, why student decided to use a phone for robot control from the beginning. I would expect to tune the motor control with a monitorable feedback before using external devices for one-way communication. Such an approach can be achieved, e.g., by using two Arduinos with Bluetooth interface - one for monitoring, second one inside the robot – so that the PID can be tuned. Figure 42. shows angle of robot at different surfaces. Why wasn't the same setup used to test different setting of the PID controller to stabilize the robot? From the description, it is not clear if the used mobile application was developed by the author, or it is some publicly available application. Figure 28 does not show how the sensor for monitoring the robot angle is connected. 5V DC motors were used, however only 3.7V battery is used to operate them.</p>	

Formal and language level, scope of thesis

C - good.

Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?

As stated in the above text, some sentences are too unnecessarily complicated. However, I understand that English is not the author's native language, but I don't understand even more why he so often chooses complicated phrases that don't make sense. The text contains many fillers that unnecessarily extend the overall length of the description. Equations 1-7 contain terms which are not explained what they represent (e.g., "A"). Figure 37 is over two pages, so the description is only under a new page. Code description should be done as a text not as a figure with black background.

Selection of sources, citation correctness

B - very good.

Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?

Thesis contains 12 references, which is enough for the bachelor thesis. I found no inconsistencies in the form of citing information sources. However, I missed a bit the references to robots in everyday life, if they have any real use - for example as toys for children. One of the most iconic robots of this kind is the one from the new Star Wars trilogy, which certainly deserves some space in the text.

Additional commentary and evaluation (optional)

Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.

I think the thesis topic had a good potential, but the quality was taken a bit down due to lack of a firm goal (more specific one). The testing phase seems rushed to me. However, there is a potential for further development and student was able to solve some problems that occurred during the design process, as well to write the program for the controller.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.

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Student selected a partially correct approach how to solve the thesis topic. The driving mechanism is based on a selected sphere robot. It is not clear, why student started to write down equations for the driving torque without substituting any real numbers to calculate it. The commercial design has a wireless charging option. Is the new mechanical design better? Does it solve something in a new way? Those question should be answered in conclusions. The conclusions states "The goal was to create a robot capable of moving in all directions and self-stabilizing, while also being adaptable for future improvements". However, there are no such words in thesis guidelines.

The technical part of the work is thoroughly commented by the student. In my opinion, some sentences are too unnecessarily complicated, which degrades the student's reasoning for choosing solution. Additionally, thesis would require further test to evaluate the design, especially the self-stabilizing procedure. It is not clear, why student decided to use a phone for robot control from the beginning. I would expect to tune the motor control with a monitorable feedback before using external devices for one-way communication. The thesis text contains

many fillers that unnecessarily extend the overall length of the description. Equations 1-7 contain terms which are not explained what they represent (e.g., "A"). Figure 37 is over two pages, so the description is only under a new page.

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The grade that I award for the thesis is **C - good**.

Date: **31.1.2023**

Signature:

Questions:

- 1) During your research (state of the art), did you come across any references to the robot from Star Wars, named as BB-8? Do you know what its internal design? If yes, did you take any inspiration from it?
- 2) You have used a mobile application to send commands to Arduino over Bluetooth. Is the application your design? Why did you choose to use an app without feedback before tuning the motor controller for stabilization in a real-time application?
- 3) Have you considered using any surface treatments for better friction (either inside or outside the ball)?
- 4) How long the robot can operate? You have used two batteries in series, but only one of them is used to drive the motors. Do you think it can lead to a problem with undervoltage, that can cause earlier battery degradation?