Palestine Technical University – Kadoorie

College of Engineering and Technology

Department of Mechanical Engineering

Course name:

Introduction to Graduation Project

Project title:

DESIGNING A BOOK SORTING MACHINE FOR PTUK LIBRARIANS IN TULKARM

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General Background:

Writing is one of the most important skills to document facts, thoughts, researches and inventions. It is important to document what you think about to clarify your idea and dispel any confusion about it. Therefore, writing, documentation and science are the greatest things humans have always cared about. Former nations and civilizations have left workbooks, folders and scripts that filled the shelves and world libraries cabinets (Spring, 1988; Shi et al., 2020). These resources have been established in order to save this heritage forward to the future generations, so that they can have access to these treasures, learn lessons and act affirmatively (Schonfeld, 2016; Jiang & Chen, 2019).

A library is an organization set of sources of knowledge that is available to community to search view and borrow. The history of libraries began with the first efforts to organize collections of documents. The role of libraries in a nation's cultural heritage is prominent, and the roles of government, places of worship or private sponsorship to develop these libraries are also significant (Spring, 1988; Schonfeld, 2016; Jiang & Chen, 2019). “Since the 1960s issues of computerization and digitization come to the fore” (Shi et al., 2020).

The university is a central and crucial stage in the students' lives. It gives several services on the academic side and improves the students’ personal characteristics. The university, therefore, is interested in building open minded characters for the students so that they can better serve their societies and build their communities. The library of the university plays an important role in achieving this goal. The university library must be established to meet these needs and help the students personally and professionally. The library of the university should not supply students with textbooks only, it has to provide books and intellectual resources that widen their knowledge, hone their skills and develop their attitudes.

Shi et al. (2020) had designed an approach that can be used to sorting books using artificial intelligence technologies, yet societal and cultural considerations had been ignored (see Spring, 1988). Jiang & Chen (2019) had shown that none of the Middle Eastern universities had such a machine and available machines are costly and complicated. A simple mechatronics system that includes sensors, processors and actuators can solve the problem and offer a great solution to the current challenges. There is a dire need to develop a sorting machine that can work effectively and efficiently for the benefit of both the librarians and the students.

Palestine Technical University - Kadoorie (PTUK) creates a unique library for the local society and the students. The PTUK library design takes into account the geometrical, environmental, social and services considerations. The PTUK library has an area of 6500 m^2, contains 49,778 books, and receives an average of 200 students per day (Bassam Al-Qasem, director of PTUK library, personal communication). Hence, this project is to be conducted in the academic year of 2022-2023 at PTUK engineering graduation laboratory. The project aimed at designing a book sorting machine that will make the life and of librarians as well as the students happier and easier.

Objectives:

The main goal of the project is to design a mechatronics system, that is established mechanically, working electrically and controlled electronically. The other objectives can be summarized as follows:

1. To return books at any time particularly beyond working hours.

2. To sort books of PTUK library to different categories.

3. To inform students about the status of books borrowed from PTUK library.

Motivations:

Many things motivate us to conduct such a project including:

1. The possibility to have a financial support to build such a real and useful project.

2. The benefit to PTUK students and librarians who want such services.

3. The ability to tackle contemporary challenges PTUK librarians and students may have.

Problem Identification:

The idea for doing this came from the need of the students in the first place then the librarian. The library is in the third floor of the library building and with no elevator in the building students sometimes have problems or too lazy to visit the library just to return a book. At the beginning and the end of every semester, librarians are busy with book inventory process and students are not allowed to enter the library. By placing this machine in the first floor the return process will be less tedious. In addition, students can return the book at any time not just at the library working hours.

As for the librarian, the average daily number of books returned is 50 books (Nashaat Mahfooz, senior librarian, personal communication). Sorting these books will take time and effort that can be saved using the proposed self-return machine. The PTUK library had already planned to buy such a machine in the Fall 2014 semester, but it had a very high cost of approximately $33,000. It is expected that the present project will cost more or less than $2,000.

Project Questions:

By completing this project, it is aimed to answer the following questions:

1. What resources do we need to technically accomplish this project?

2. How much books can the machine return per minute?

3. What is the accuracy of sorting to the machine?

4. Which communication channel between librarians and students is preferred?

Working Method:

There are many methods to conduct this project, yet we are looking for the method that is simple, modern and reliable in the same time (e.g., Shi et al., 2020). The design and basic idea are very simple; sorting books by their subject, e.g., Biology, Physics, Engineering, etc. The book enters the machine through a door or a small window, the sensor reads the book tag and sends signal to the controller, the motor drives the belt which the book lies on and the piston will push the book to the right box by its subject, a basic model is shown in the Figure 1.

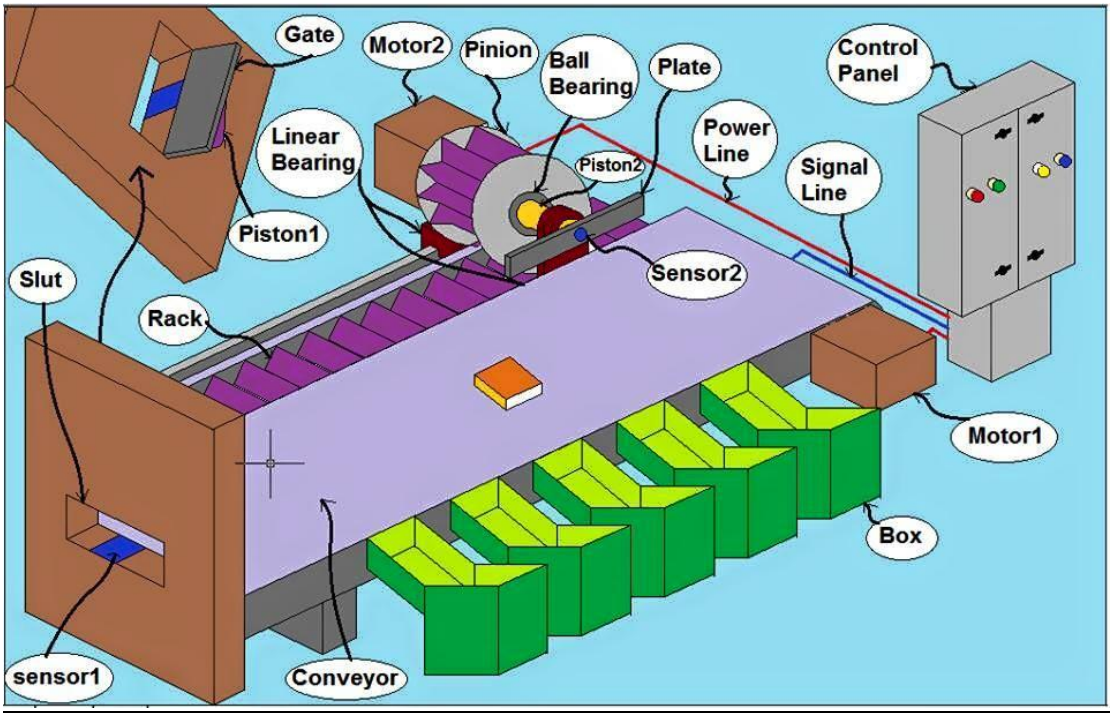

Figure 1: A basic model of the book sorting machine to develop.

Expected Results:

At the end of this project, the following results are expected to get:

1. Designing a powerful mechatronics system that can solve contemporary challenges to customers of PTUK library.

2. Students being able to return books in weekends and vacation days.

3. Returning and sorting five books per minute with an accuracy of 80%.

Project Timeline:

We are supposed to start working on this by the beginning of the Fall 2022 semester and finish it by the end of the Spring 2023 semester. The proposed project timeline shown in Table 1 serves as a guide to follow during the period of accomplishing this task. The project timeline is flexible to accommodate for any changes or surprises in the schedule. The suggested timeline of the project will be updated as the further the group progresses in time and the picture becomes clearer.

Table 1: The proposed timeline of the project.

Week no.	**Tasks**
1 – 2	Buying the components and parts of the machine
3 – 5	Building the machine and programming the microcontroller
6 – 12	Testing the machine and trouble-shooting process
10 – 15	Writing and proofreading the thesis and preparing presentation
15 – 16	Defending

OR:

Month	February				March				April				May			
Task / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Buying components																
Building machine																
Testing machine																
Writing thesis																
Defending																

References:

Jiang, J., & Chen, P. (2019). Layout optimization of book sorting machine based on sequential control. In: J. Hung, N. Yen, & L. Hui (Eds.), *Frontier computing* (pp. 887-895). Springer, Singapore. **Book Chapter**

Schonfeld, R.C. (2016). *How should we organize the academic library? The view from the director's chair*. Retrieved from https://sr.ithaka.org/blog/how-should-we-organize-the-academic-library/ **Website**

Shi, X., Tang, K., & Lu, H. (2020). Smart library book sorting application with intelligence computer vision technology. *Library Hi Tech*, *39*(1), 220–232. **Journal Article = Scientific Paper**

Spring, J.H. (1988). *The sorting machine revisited: National educational policy since 1945* (1st ed.). Addison-Wesley Longman, IL, USA. **Published Book**