Project Notes:

Project Title: A robotic arm to organize books in a library
Name: Cecilia Carbonell

Note Well: There are NO SHORT-cuts to reading journal articles and taking notes from them. Comprehension is paramount. You will most likely need to read it several times, so set aside enough time in your schedule.

Contents:

Knowledge Gaps:

This list provides a brief overview of the major knowledge gaps for this project, how they were resolved and where to find the information.

Knowledge Gap	Resolved By	Information is located	Date resolved
Robot Motion	Research Articles	Project Notes Summaries	10/6/2023
Robot Construction	Research Articles	Project Notes Summaries	10/16/2023
Arduino Programming	Arduino Student Kit	Github	10/16/2023
Barcode Scanner Compatibility	Adafruit Website Descriptions	N/A (Pivoted Away)	10/13/2023
Optical Character Recognition	Research Articles	Project Notes Summaries	12/20/2023

Literature Search Parameters:

These searches were performed between (Start Date of reading) and XX/XX/2019.
List of keywords and databases used during this project.

Database/search engine	Keywords	Summary of search
IEEE XPlore Digital Library	Robot Arm	Lots of information on medical applications
ScienceDirect	Scanner	Not specific enough, lots of information on biology
ScienceDirect	RFID Scanning	Not much about the technology itself, but a lot on applications
ScienceDirect	Barcode Scanning	Also more on applications, but with some interesting technological articles
ScienceDirect	Robot Arm	Lots of relevant information

Tags:

Tag Name	
Arm	Barcode
Blur	Claw
Deep-Learning	Fruit
Humans	Immunotherapy
Optimization	Safety
Scanner	Segmentation

Speed	Two-Dimensional

Article #1 Notes: Title

Article notes should be on separate sheets

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Source Title	
Source citation (APA Format)	
Original URL	
Source type	
Keywords	
#Tags	
Summary of key points + notes (include methodology)	
Research Question/Problem/ Need	
Important Figures	
VOCAB: (w/definition)	
Cited references to follow up on	
Follow up Questions	

Article #1 Notes: Do Antihistamines Make Allergies Worse?

Source Title	Do Antihistamines Make Allergies Worse?
Source citation (APA Format)	Kaplan, M. (2008). Do antihistamines make allergies worse? *Nature (2008)*. https://doi.org/10.1038/news.2008.436
Original URL	https://doi.org/10.1038/news.2008.436
Source type	Article
Keywords	Allergies, Antihistamines, Immunotherapy
#Tags	#Allergies #Antihistamines #Immunotherapy
Summary of key points + notes (include methodology)	In order to test whether antihistamines worsen allergic reactions, fifty mice were injected with bee venom and half of them were given antihistamines for the surrounding three days. When the mice were injected with the venom again, the mice given antihistamines had worse reactions, but mice given immunotherapy had lessened reactions. The researchers suspect that the antihistamines prevented the mice's immune systems from developing a response to bee venom, but the proper dosage of antihistamines for mice is still unknown, which may have impacted the study.
Research Question/Problem/ Need	What are the impacts of antihistamines on allergies?
Important Figures	None
VOCAB: (w/definition)	Antihistamine: A medication that treats allergic reactions Immunotherapy: Gradual exposure to allergens used to treat allergic reactions
Cited references to follow up on	Johansen, P. et al. *Clin. Exp. Allergy* DOI 10.1111/j.1365-2222.2007.02904.x (2008) Ohashi, Y., Nakai, Y. & Murata, K. *Ann. Allergy Asthma Immunol.* 96, 600-605 (2006) Müller, U., Hari, Y. & Berchtold, E. *J. Allergy Clin. Immunol.* 107, 81-86 (2001)
Follow up Questions	Do different antihistamines have different outcomes? Do the reactions become normal again after taking the antihistamines for a longer time? Do antihistamines targeting H-2 receptors have different outcomes?

Article #2 Notes: Buckyballs Could Help Fight Allergies

Source Title	Buckyballs Could Help Fight Allergies
Source citation (APA Format)	Birch, H. Buckyballs could help fight allergies. *Nature* (2007). https://doi.org/10.1038/news070702-16
Original URL	https://doi.org/10.1038/news070702-16
Source type	Article
Keywords	Buckyballs, Allergies, Nanoparticles
#Tags	
Summary of key points + notes (include methodology)	Buckyballs, also called buckminsterfullerenes, have been shown in the past to have a high electron affinity that allows them to stop so-called “free radicals,” which are harmful to humans. They were also able to significantly block the release of histamine when placed in a dish with mast cells and exposed to a pollen-mimicking particle.
Research Question/Problem/ Need	Can buckyballs be used to reduce the impact of allergies?
Important Figures	None
VOCAB: (w/definition)	Buckyballs/Buckminsterfullerenes: 60 carbon atoms arranged in a sphere, resulting in high electron affinity Electron Affinity: Strength of attraction between an atom and electrons Fullerenes: Carbon atoms arranged in a sphere Mast Cell: A type of immune cell Mediators: Chemicals that help develop allergic reactions
Cited references to follow up on	Dugan, L. L.et al. Proc. Natl. Acad. Sci. 94 , 9434-9439 (1997). Ryan, J. J.et al. J. Immunol. 179 , 665-672 (2007).
Follow up Questions	Has the mechanism used by buckyballs to prevent the release of histamine been discovered? Do buckyballs block other molecules associated with allergies? What impact do buckyballs have on other immune cells?

Article #3 Notes: An imperceptible barcode can reduce the muscle activity required to scan common consumer packaged goods

Article notes should be on separate sheets

Source Title	ScienceDirect
Source citation (APA Format)	Gallagher, K. M., Jensen, M., Payne, M., & Towne, R. (2019). An imperceptible barcode can reduce the muscle activity required to scan common consumer packaged goods. *International Journal of Industrial Ergonomics*, *72*, 80–85. https://doi.org/10.1016/j.ergon.2019.04.009
Original URL	https://doi.org/10.1016/j.ergon.2019.04.009
Source type	Research Article
Keywords	Barcode, Scanner
#Tags	#barcode #scanner
Summary of key points + notes (include methodology)	The Universal Product Code (UPC,) found on prepackaged food, has remained unchanged since the 1970s. The study performed in the article compares the UPC with two other types of barcode layout: the imperceptible barcode (IB,) and the multi-sided barcode (MB). Cashiers from a grocery store in Arkansas were given time to practice with the different barcode types and then scanned the products. With the new barcodes, the cashiers were more efficient, and muscular scans showed less strain being placed on the arms and shoulders.
Research Question/Problem/ Need	Does the type of barcode on a package impact the strain put on a grocery store cashier's arm and shoulder muscles?

Important Figures	  **Performs Like This** **Looks Like This** Imperceptible barcode   Multi-sided barcode
VOCAB: (w/definition)	Universal Product Code: The barcode that appears on most pre-packaged foods Imperceptible Barcode: A barcode that repeats around the entire package, not visible Multi-Sided Barcode: A barcode that is either larger, in a more prominent location, in multiple locations, or in a different shape than a UPC
Cited references to follow up on	Raising the barcode scanner: technology and productivity in the retail sector Am. Econ. J. Appl. Econ., 4 (3) (2012), pp. 1-27
Follow up Questions	● Did cashiers with one year of experience perform differently than those with five years? ● Did it make a difference that to compare with MB the extra barcodes were hidden so that it was easier to find? That may have impacted the amount of turning done by the cashier. ● Was there a specific control group or did the researchers just look at data for cashiers? If so, were the cashiers in the control from the same area? ● How did the scanner change between the barcode types? ● Do part-time employees show the same results?

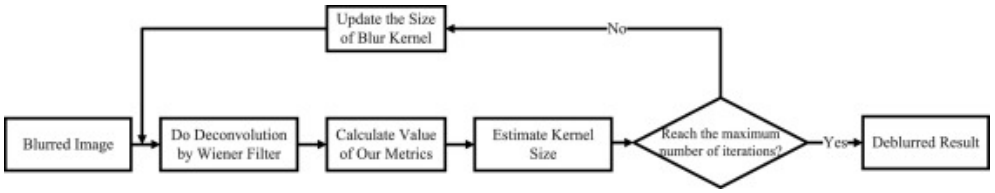
Article #4 Notes: A universal product code scanner is a feasible method of measuring household food inventory and food use patterns in low-income families

Article notes should be on separate sheets

Source Title	A universal product code scanner is a feasible method of measuring household food inventory and food use patterns in low-income families
Source citation (APA Format)	Weinstein, J. L., Phillips, V., MacLeod, E., Arsenault, M., & Ferris, A. M. (2006). A universal product code scanner is a feasible method of measuring household food inventory and food use patterns in low-income families. *Journal of the American Dietetic Association*, *106*(3), 443–445. https://doi.org/10.1016/j.jada.2005.12.004
Original URL	https://doi.org/10.1016/j.jada.2005.12.004
Source type	Research Article
Keywords	Speed, Barcode, Scanner
#Tags	#barcode #scanner #speed
Summary of key points + notes (include methodology)	Many nutritionists working with low-income families like to know what foods are in the house, but cataloging those foods can be invasive and tedious. The researchers used a UPC scanner to identify the foods that each family had in their house and then double-checked their results. They found that the scanner saved a significant amount of time and was less intrusive, although it lacked storage for all of the food in each house.
Research Question/Problem/ Need	How can a UPC scanner be used to make food cataloging of low-income households faster and less intrusive?

Important Figures	<table><tr><th>Food group</th><th>% Correctly matched[a]</th><th>No. matched</th><th>% Incorrectly matched[b]</th><th>No. missed</th></tr><tr><td>Vegetables</td><td>97.7</td><td>1,107</td><td>2.3</td><td>26</td></tr><tr><td>Fats, oils</td><td>96.2</td><td>179</td><td>3.8</td><td>7</td></tr><tr><td>Legumes, dry beans, peas, nuts</td><td>96.2</td><td>651</td><td>3.8</td><td>26</td></tr><tr><td>Milk and dairy products</td><td>96.0</td><td>360</td><td>4.0</td><td>15</td></tr><tr><td>Grain products</td><td>95.9</td><td>1,605</td><td>4.1</td><td>68</td></tr><tr><td>Miscellaneous</td><td>95.1</td><td>97</td><td>4.9</td><td>5</td></tr><tr><td>Eggs</td><td>94.7</td><td>18</td><td>5.3</td><td>1</td></tr><tr><td>Meat, fish, poultry</td><td>94.0</td><td>724</td><td>6.0</td><td>46</td></tr><tr><td>Fruits</td><td>93.8</td><td>256</td><td>6.2</td><td>17</td></tr><tr><td>Sugars, sweets</td><td>93.4</td><td>595</td><td>6.6</td><td>42</td></tr><tr><td>Spices</td><td>91.9</td><td>68</td><td>8.1</td><td>6</td></tr></table> Accuracy by food type
VOCAB: (w/definition)	Line-item inventory: A list of all things in the inventory
Cited references to follow up on	None
Follow up Questions	• How can the memory of the scanner be improved? • Is the scanner affordable for families struggling with food insecurity? • How can the food be scanned without having to unpack all of the shelves? • Could the scanner be made faster?

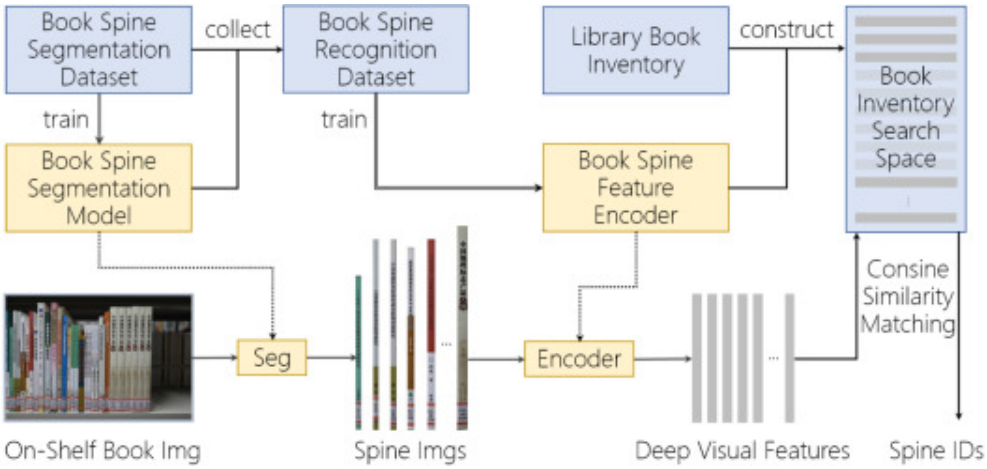
Article #5 Notes: Fast Linear Motion Deblurring for 2D Barcode

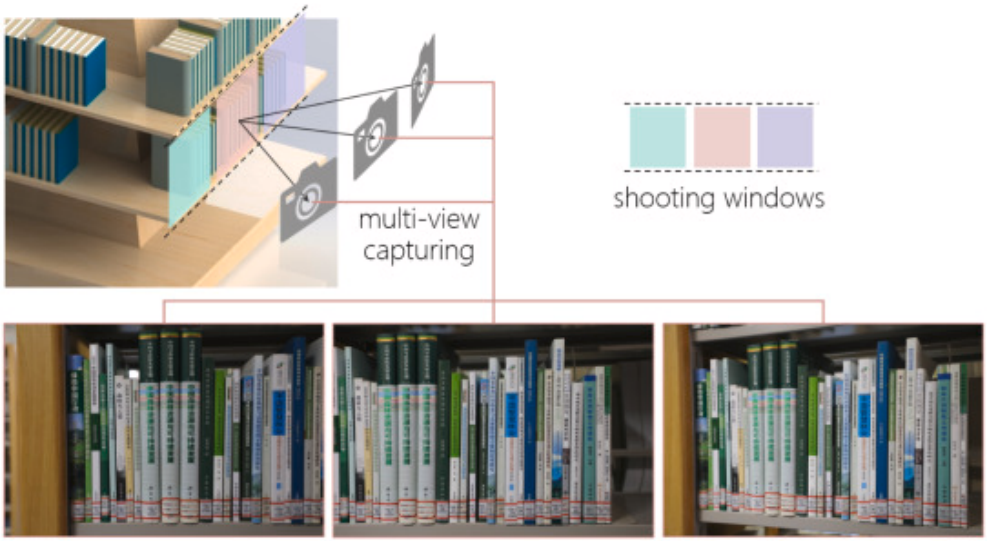
Source Title	ScienceDirect
Source citation (APA Format)	Shi, Y., He, B., Zhu, M., & Zhang, L. (2020). Fast linear motion deblurring for 2D barcode. *Optik*, *219*, 164902. https://doi.org/10.1016/j.ijleo.2020.164902
Original URL	https://doi.org/10.1016/j.ijleo.2020.164902
Source type	Research Article
Keywords	Barcode, Scanner, Blur, Two-Dimensional
#Tags	#barcode #blur #scanner #Two-Dimensional
Summary of key points + notes (include methodology)	Many 2D barcodes cannot be scanned quickly because they are easily blurred and de-blurring methods take a long time. In order to fix this, the researchers created a program that can conduct a line search to identify the best blur kernel, essentially using a brute force approach to deblurring the barcode. Their method was quicker than many preexisting methods.
Research Question/Problem/ Need	Two dimensional barcodes are popular, but it's difficult to quickly scan them because of blurring.
Important Figures	 Deblurring steps

	 Different stages of deblurring
VOCAB: (w/definition)	Blur kernel: makes something more blurry Latent image: a developed picture 2D barcode: QR Code Line search: identifying something by going down a list
Cited references to follow up on	
Follow up Questions	● Would this system work for 1D barcodes? ● Would this system work for other types of 2D barcode?

Article #6 Notes: Library on-shelf book segmentation and recognition based on deep visual features

Article notes should be on separate sheets

Source Title	ScienceDirect
Source citation (APA Format)	Zhou, S., Sun, T., Xia, X., Zhang, N., Huang, B., Xian, G., & Chai, X. (2022). Library on-shelf book segmentation and recognition based on deep visual features. *Information Processing & Management*, *59*(6), 103101. https://doi.org/10.1016/j.ipm.2022.103101
Original URL	https://doi.org/10.1016/j.ipm.2022.103101
Source type	Research Article
Keywords	Deep Learning, Segmentation
#Tags	#Deep-learning #Segmentation
Summary of key points + notes (include methodology)	The researchers developed a deep learning model that can take an image of books on a shelf, split up the books, and recognize each book using reference images uploaded by librarians at that specific library. The AI was trained using the National Agricultural Library of CAAS and was 98% accurate. The program can be used for books in any language, but is limited to the books uploaded by the librarians.
Research Question/Problem/ Need	It is important to keep books on library shelves in order, but this takes a lot of time from librarians
Important Figures	 Steps in identifying books

	 How the camera gets a full view of the shelf  The robot takes six different versions of each spine
VOCAB: (w/definition)	Deep Learning: Deep learning teaches a machine to recognize something based on similarity to things that it's already seen Optimal Character Recognition: The conversion of text in an image to text that a computer can understand Segmentation: Breaking a group into smaller parts that can be individually recognized
Cited references to follow up on	
Follow up Questions	• How could the scanner communicate to a librarian that a book is in the wrong place? • Is there a system in place to find the books that were marked incorrectly? • What do librarians think of this device? Is it easy for them to use? Are they worried about automation?

Article #7 Notes: Design and development of a low-cost 5-DOF robotic arm for lightweight material handling and sorting applications: A case study for small manufacturing industries of Pakistan

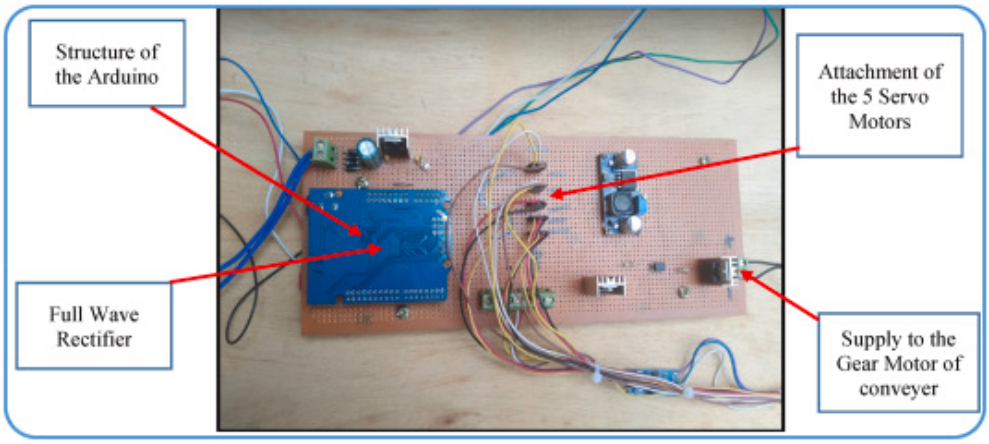
Article notes should be on separate sheets

Source Title	Design and development of a low-cost 5-DOF robotic arm for lightweight material handling and sorting applications: A case study for small manufacturing industries of Pakistan
Source citation (APA Format)	Ali, Z., Sheikh, M. F., Al Rashid, A., Arif, Z. U., Khalid, M. Y., Umer, R., & Koç, M. (2023). Design and development of a low-cost 5-DOF robotic arm for lightweight material handling and sorting applications: A case study for Small Manufacturing Industries of Pakistan. *Results in Engineering*, *19*, 101315. https://doi.org/10.1016/j.rineng.2023.101315
Original URL	https://doi.org/10.1016/j.rineng.2023.101315
Source type	Research Article
Keywords	Arm, 5 DOF, Claw
#Tags	#arm #DOF #claw
Summary of key points + notes (include methodology)	In Pakistan, many factories cannot afford expensive robotic arms to do the tedious sorting required for day-to-day operation, but this paper outlines the design of a cost-effective robotic arm. The arm is made out of aluminum and can move on five axes. It is controlled with Servo motors and an Atmega328 on an Arduino Uno and was designed to move in a small space, pick up relatively small objects and sort them after scanning them, and be lightweight and cost-effective. The team designing the robot used SOLIDWORKS for the design and then put the SOLIDWORKS file into ANSYS to analyze its stability.
Research Question/Problem/ Need	Most industries in Pakistan that would benefit from having access to a robotic arm can't afford it.

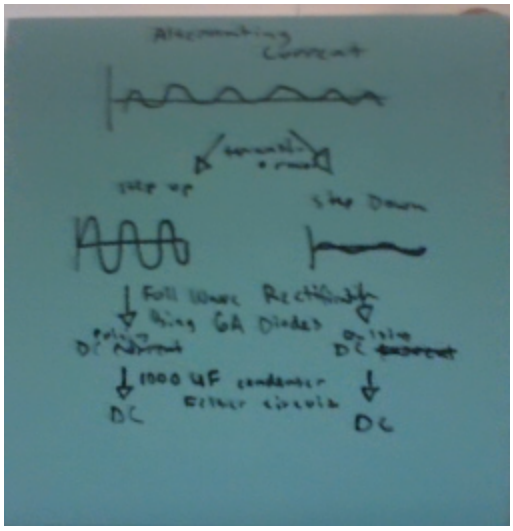
Important Figures

Material	Cost	Advantages	Constrained/Disadvantages	Ref.
Metals/Alloys	Cost-effective	• Can lift heavy weight. • Successfully employed in any production industry. • Embedded security features.	• Only detect large strains. • The heavyweight robotic arm. • Expensive if base metal/alloys are from nickel, chromium etc. • Wide working space is usually required.	[35,36]
Composites Materials	Moderate expensive	• The robotic arm is lightweight. • Can detect small strains. • Simple operation. Simple programming.	• The viscoelastic behavior of polymeric composites caused a delay in response. • Hysteresis	[37,38]
Soft Polymeric Materials (Soft robots)	Expensive	• Based on the entire motorless deformation mechanism. • Can detect much smaller strains. • Can lift toxic objects in extreme environmental conditions. • Can operate in limited space. • Flexibility of deployment.	• Relatively new technology has limited commercial applications. • Usually lift lightweight objects. • Programming under stimulant conditions is time-consuming.	[[39], [40], [41]]

Table outlining pros and cons of arm materials



Circuitry of robotic arm



Graphical abstract of current management, drawn by me

S/N	Joint name	Total resistance torque (kg. cm)	Servo motor specifications	Servo motor name
1	Grip joint		Torque of 1.8 kg/cm at 4.8V	Tower proSG 90
2	Wrist joint	T4g+T4i=6.012×10^{-4}	Torque of 9.4 kg/cm at 4.8V	TowerproMG 995
3	Elbow joint	T3g+T3i=2.756	Torque of 9.4 kg/cm at 4.8V	TowerproMG 995
4	Shoulder joint	T2g+T2i=6.055	Torque of 9.4 kg/cm at 4.8V	TowerproMG 995
5	Base joint	T1g+T1i=0.3040	Torque of 9.4 kg/cm at 4.8V	Towerpro MG995

Table used to identify best servo motor

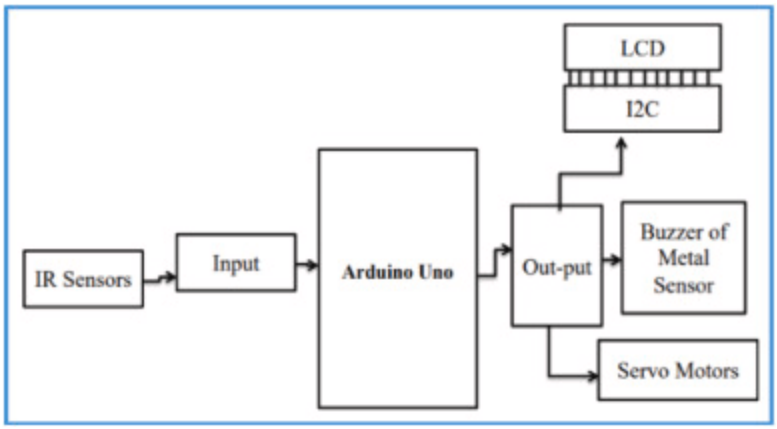
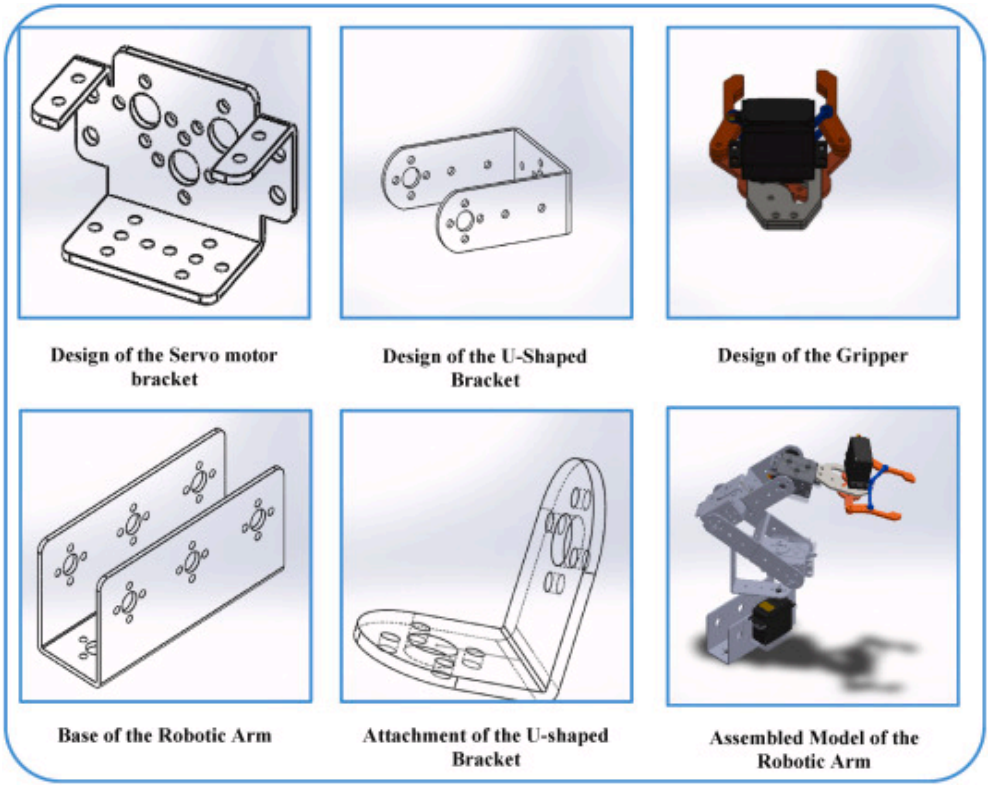


Diagram of how the Arduino was incorporated

Specification	**Number of the Axis**	**5 Axis**
	Payload	1 kg
	Power supply	110 V/220 V, 50/60 Hz
	Power in	12 V/3 A
Axis Movement	**Axis**	**Range**
	Joint 1 base	θ_1
	Joint 2	$90^\circ - \theta_2$
	Joint 3	θ_3
	Joint 4	$180^\circ - \theta_4$
	Joint 5	180°
Physical	Weight	2.9 kg
	Dimenssion	200 mm × 150 mm
	Materials	Aluminum
	Controller	Arduino

Table with arm design information



Parts of the arm created with CAD

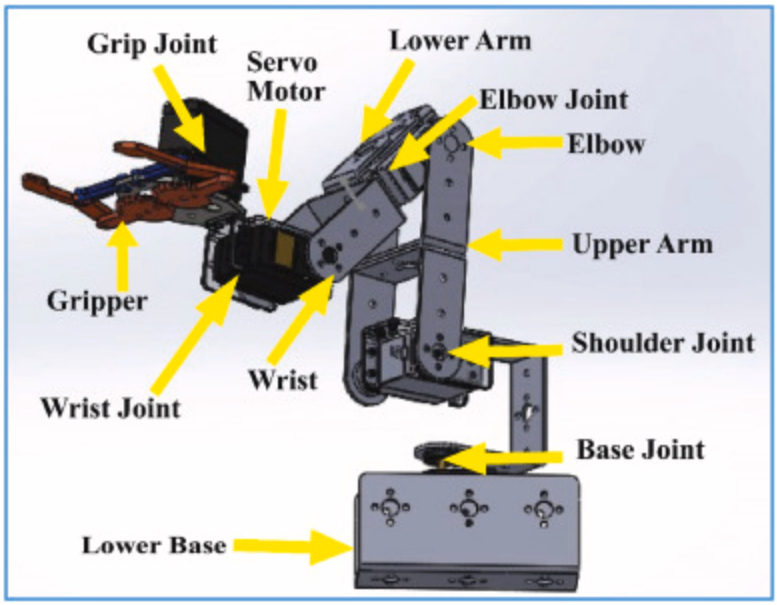
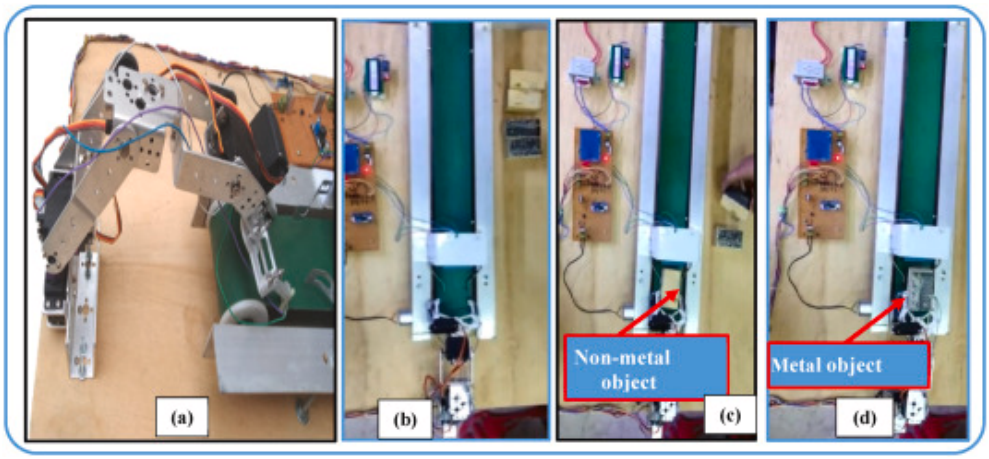


Diagram of full arm



(a) The robot in action
(b) The robot at rest
(c) The object being sorted to the right
(d) The object being sorted to the left

Part Name	Unit Price (PKR)	Total Price (PKR)
Railing	1000 Per Feet	6000
Rollers	250	1000
Belt	400	2400
LCD+I2C	–	500
Step down transformer	500	500
Arduino Uno Board	–	3500
Wiring	–	1000
IR sensors	–	200
Magnetic sensor+buzzer	–	500
Robotic arm material (aluminum)	–	8000
Gear motor	800	800
Servo motors	1200	6000
Fabrication cost	–	3000
Total cost in PKR	–	**33600**
Total Cost in USD	–	**~ 120**

The robot arm was built for around $120.00, including the rail

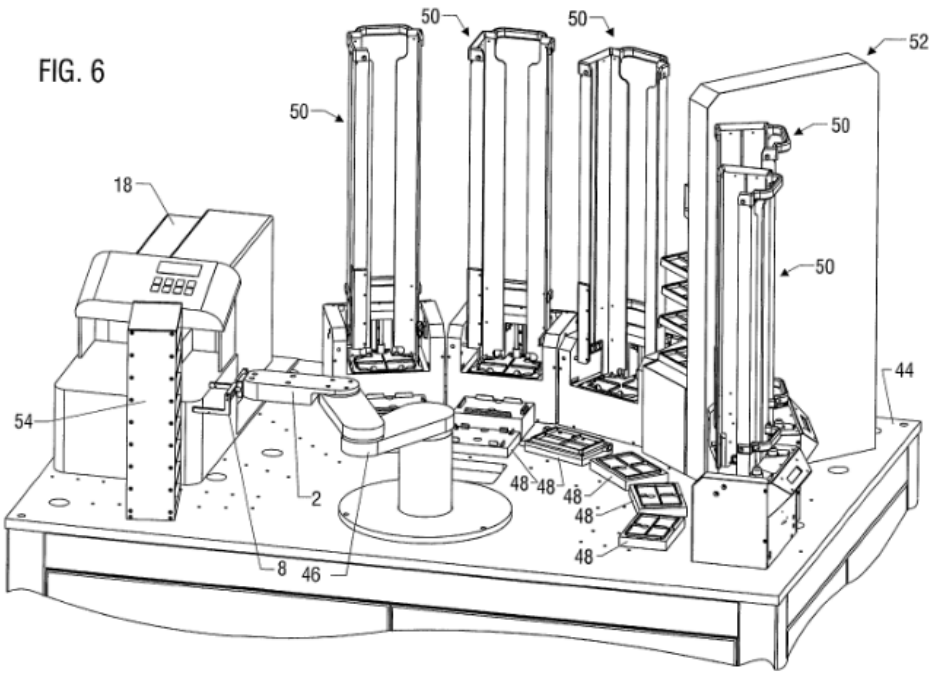
VOCAB: (w/definition)

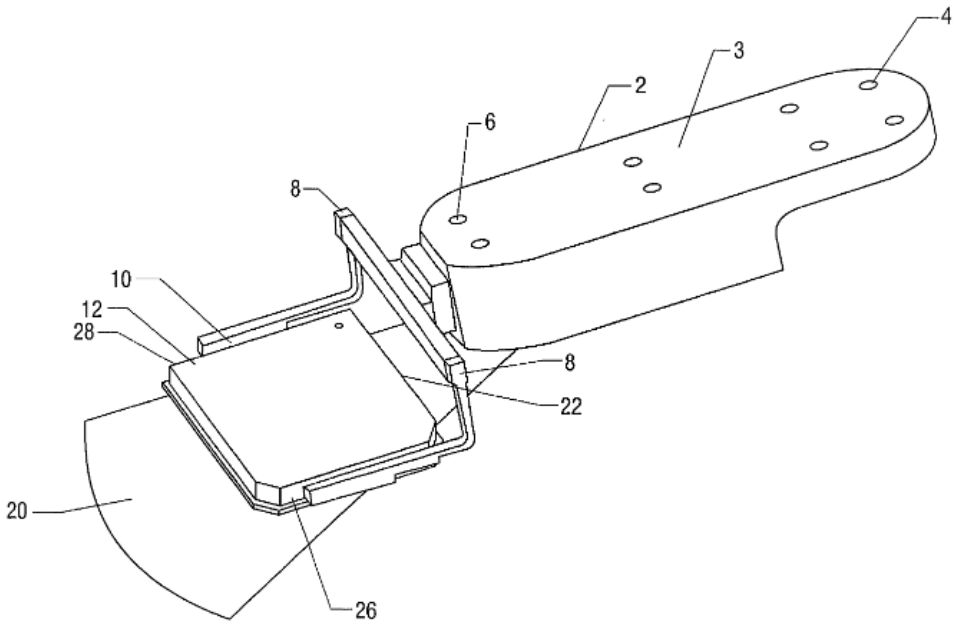
Kinematic Chain: A series of parts connected by movable joints.
Translational vs. Rotational Displacement: Translational displacement is how much something has moved and rotational displacement is how much something has

	turned Microcontroller: A microcontroller is a small computer, usually used for one project, as opposed to a computer that might be used for multiple purposes. Inverse Kinematics Control: Inverse kinematics control uses kinematic equations to predict the movement of a robot Finite Element Analysis: FEA is used to predict how a product will perform in different conditions Servo Motor: A servo motor is used to push and rotate elements of a machine Atmega328: Microcontroller compatible with Arduino Uno
Cited references to follow up on	Review on design and development of intelligent robotic arm GUI based pick and place robotic arm for multipurpose industrial applications Evolution of robotic arms Development of a microcontroller based robotic arm
Follow up Questions	● Has this been used in any industries? If so, was it effective? ● How can the arm determine whether to raise or lower the N:Np ratio?

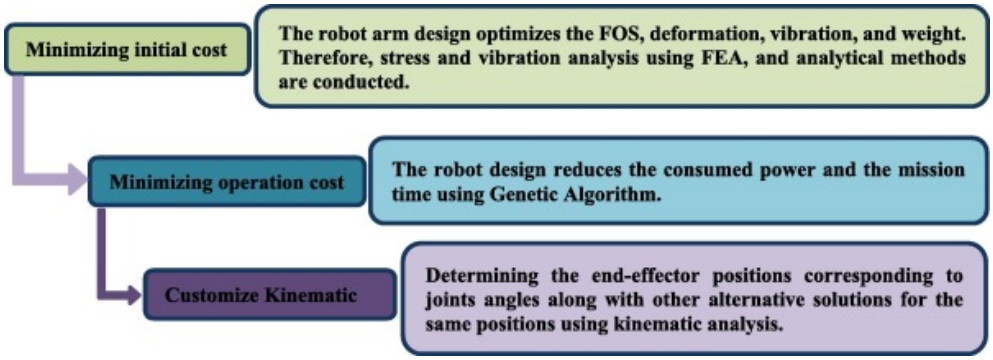
Patent #1 Notes: Robot mounted barcode reader

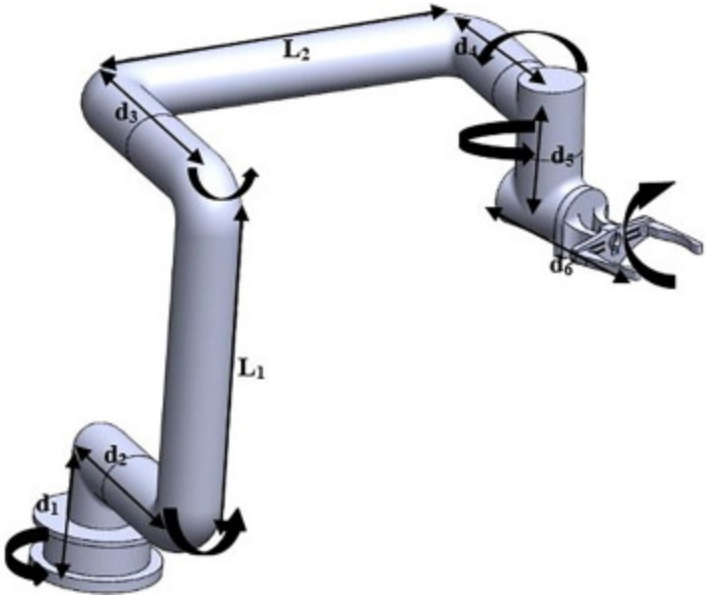
Article notes should be on separate sheets

Source Title	Google Scholar
Source citation (APA Format)	Bevirt, J., & Brinton, G. (2002, October 17). Robot mounted barcode reader.
Original URL	https://patents.google.com/patent/US20020150450A1/en
Source type	Patent
Keywords	Robot arm, Robot claw, Scanner
#Tags	#arm #claw #Scanner
Summary of key points + notes (include methodology)	The device has a claw with a barcode scanner mounted under it. The claw is moved by the device to different stations that can carry out different parts of an experiment. The arm scans each item that it picks up immediately and that information is put into a computer system for record-keeping.
Research Question/Problem/ Need	In a laboratory, a robotic arm can be used to efficiently conduct DNA sequencing, but the robotic arm needs a way to identify what it's carrying.
Important Figures	 The entire machine, with arm center

	 The arm with scanner beneath, represented by the angle
VOCAB: (w/definition)	None
Cited references to follow up on	https://patents.google.com/patent/US20020150450A1/en
Follow up Questions	• In my device, could I mount the scanner inside of the claw? • Does the light harm the specimens on the plate? Is there a way around that?

Article #8 Notes: A multi-objective optimization design of industrial robot arms

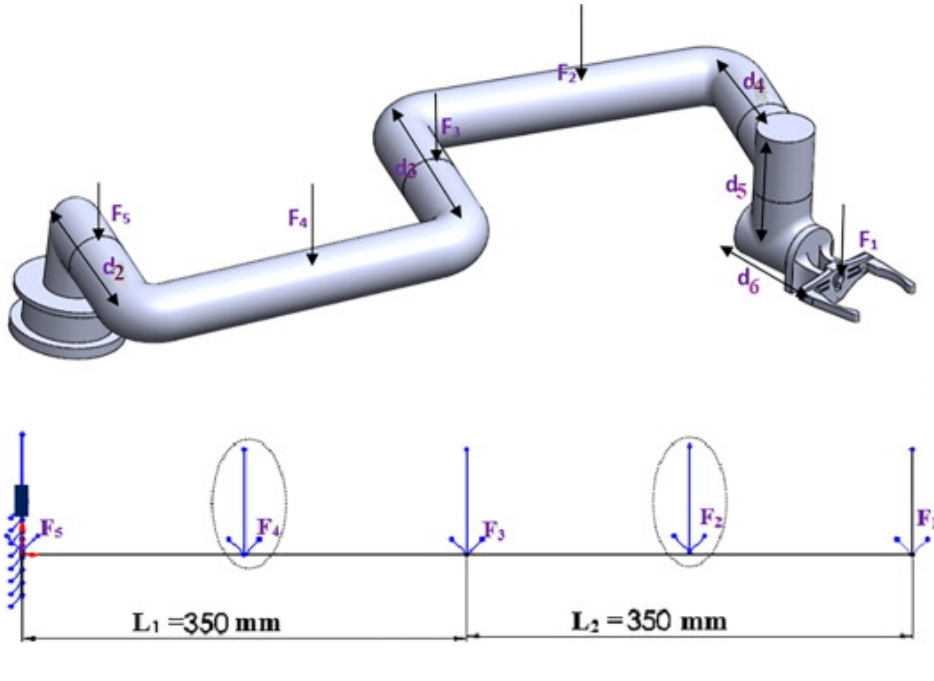
Source Title	Alexandria Engineering Journal
Source citation (APA Format)	Kouritem, S. A., Abouheaf, M. I., Nahas, N., & Hassan, M. (2022). A multi-objective optimization design of industrial robot arms. *Alexandria Engineering Journal*, *61*(12), 12847–12867. https://doi.org/10.1016/j.aej.2022.06.052
Original URL	https://doi.org/10.1016/j.aej.2022.06.052
Source type	Journal Article
Keywords	Arm, Optimization
#Tags	#arm, #optimization
Summary of key points + notes (include methodology)	This paper provides an in-depth explanation of the process used to test designs of a robotic arm. Tests were performed using ANSYS software and the robot was designed in SolidWorks. In order to determine the proper material for the robot that the team designed, they looked at their criteria (low cost and high carrying capacity) and compared various factors with the interior diameter of different materials. They decided to use an aluminum alloy. In order to decrease the stress put on the robot, all of the parts marked by ANSYS as high stress were made of magnesium. By using the aluminum alloy, the engineers were able to build a low-cost, lightweight robotic arm capable of moving quickly and accurately while carrying loads between two and 16 kilograms. The operating costs were also reduced by using a polynomial to analyze torque and then minimizing it.
Research Question/Problem/ Need	How can a robotic arm most effectively be tested?
Important Figures	 The three major considerations made in optimization of the arm

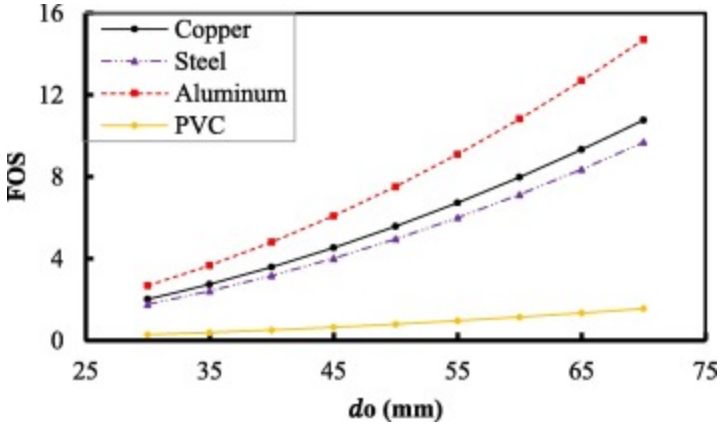
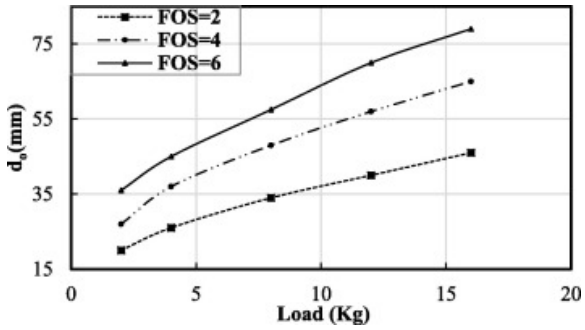


The model of the arm created in SolidWorks, with variables labelled

Parameter	Description	Value	Parameter	Description	Value
d_1	length of the base	45 mm	d_2	offset of joint 2	130 mm
d_3	the offset of joint 3	140 mm	d_4	offset of gripper joint	90 mm
d_5	the offset of gripper joint	115 mm	d_6	offset of gripper joint	82 mm
L_1	length of planar link 1	350 mm	L_2	length of planar link 2	350 mm

A table corresponding to some of the values in the model in SolidWorks

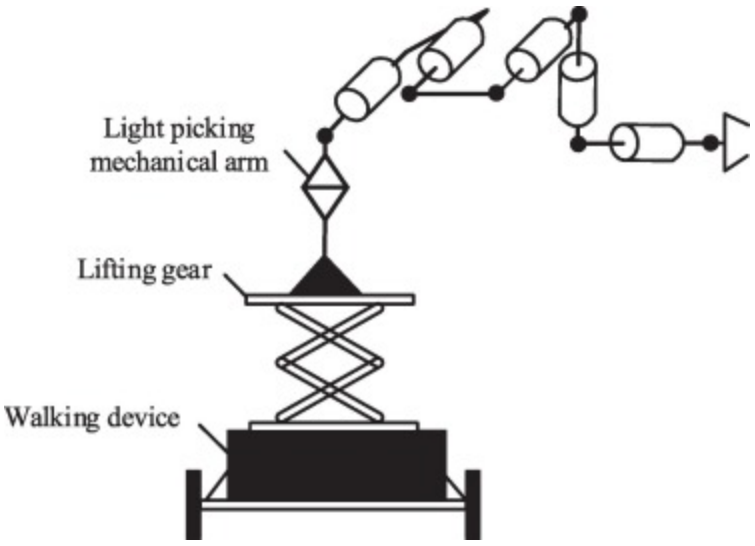


	A model created with MATLAB to test the robot at its furthest reach  A graph comparing the strengths of different materials under different levels of stress  A graph comparing the outer diameter of the robotic arm with the load that it's capable of carrying
VOCAB: (w/definition)	Denavit-Hartenberg Parameters: The DH parameters are used to determine aspects of robot design like length and axes. Genetic Algorithm: An equation used for optimization based on natural selection. Finite Element Method: A strategy for solving differential equations in engineering. Factor of Safety: Used to determine how much stronger a machine is than is necessary. Natural Frequencies: The frequency at which something vibrates when touched. Resonance Frequencies: The frequency at which something vibrates the most.
Cited references to follow up on	Van Willigenburg, Optimal manipulator design for a cucumber harvesting robot J.J. Craig, Introduction to Robotics: Mechanics and Control, third ed., Pearson Prentice Hall, 2005. R.M. Murray, Z. Li, S.S. Sastry, A Mathematical Introduction to Robotic Manipulation, CRC Press, 1994.
Follow up Questions	● How was the robot designed initially? ○ Was this level of math incorporated at that time or just while conducting simulations? ● What was this robot designed to do?

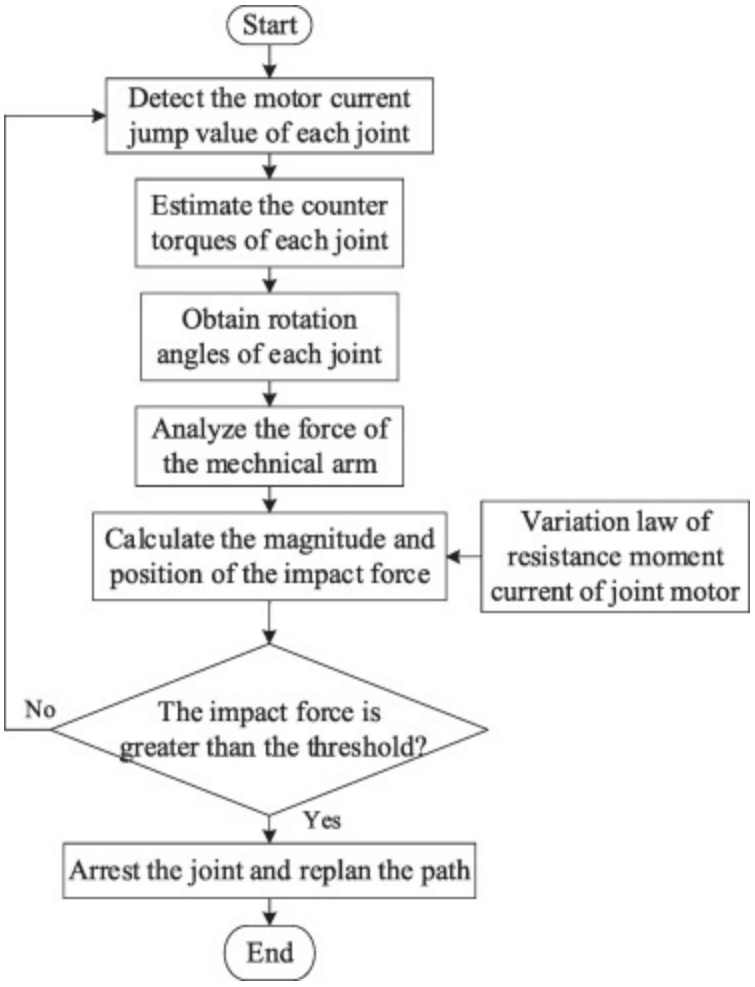
Article #9 Notes: Lightweight force-sensing tomato picking robotic arm with a “global local” visual servo

Source Title	Computers and Electronics in Agriculture
Source citation (APA Format)	Shi, Y., Jin, S., Zhao, Y., Huo, Y., Liu, L., & Cui, Y. (2023). Lightweight force-sensing tomato picking robotic arm with a “global-local” visual servo. *Computers and Electronics in Agriculture*, *204*, 107549. https://doi.org/10.1016/j.compag.2022.107549
Original URL	https://doi.org/10.1016/j.compag.2022.107549
Source type	Journal Article
Keywords	Arm, Claw, Humans, Safety
#Tags	#Arm #Claw #Humans #Safety
Summary of key points + notes (include methodology)	One of the main problems confronting the engineers was the identification of ripe fruits. In order to find the ripest fruit, the binocular and monocular methods were combined. The robot started by looking for the reddest tomatoes with a binocular system and then identifying the largest tomato using a monocular system and slowly moving in. It was also important to develop a system that wouldn’t squish the tomatoes. In order to do this, they used the system shown in the flowchart below. The arm was constructed with 3D printed joints(PLA) connected by carbon fiber tubes. The robot was also designed to be able to turn off after it hits something with a certain force.
Research Question/Problem/ Need	Automated tomato picking requires a machine that can handle large quantities anad interacting with human tomato-pickers while being inexpensive and lightweight.

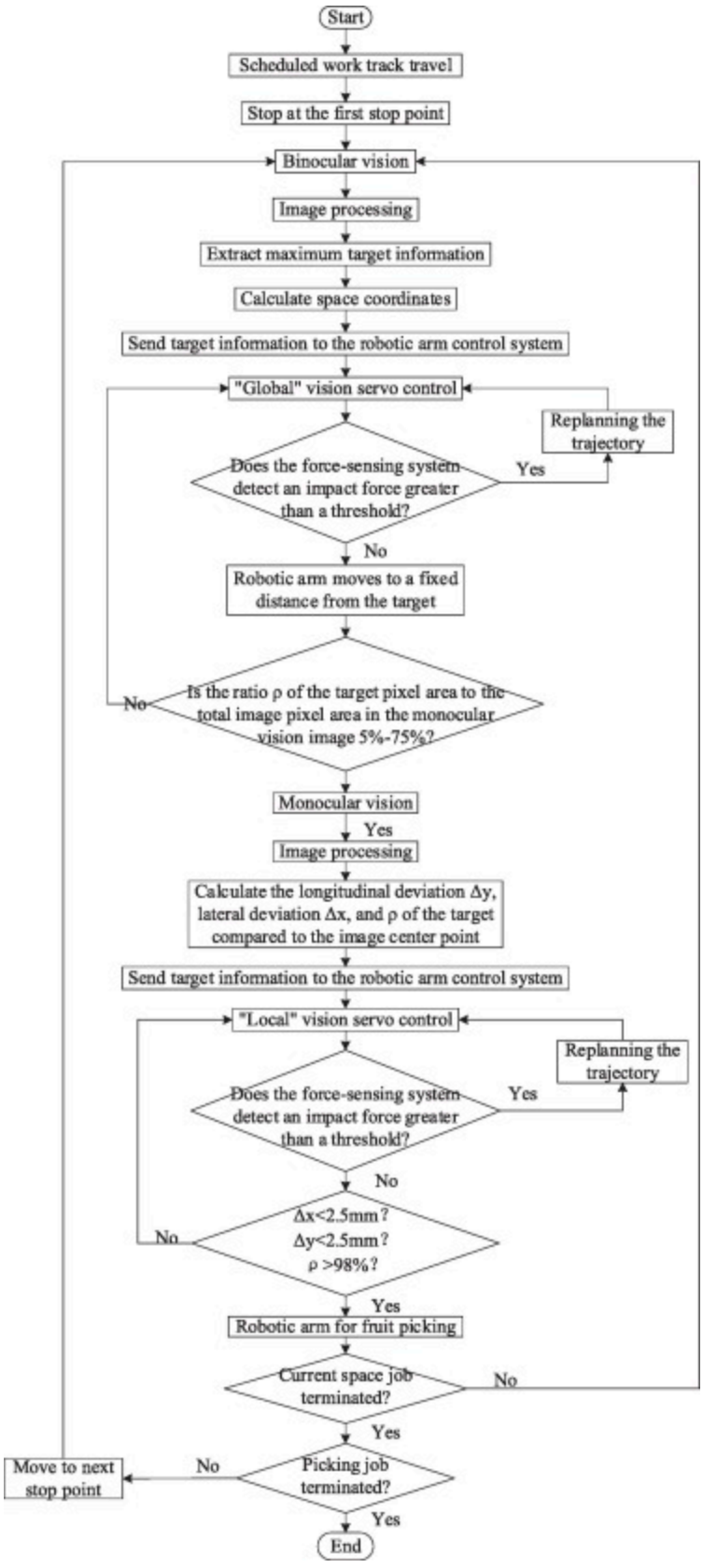
Important Figures

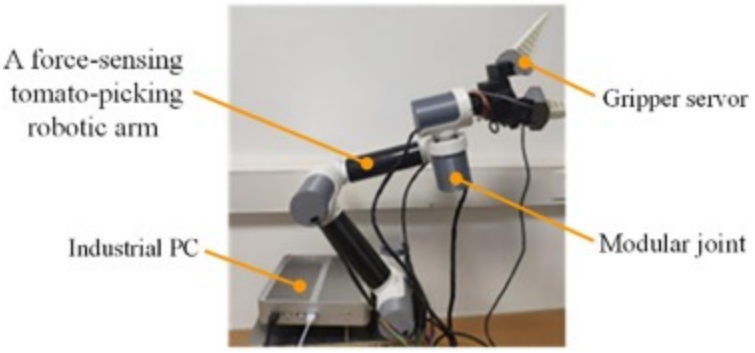


A basic diagram of how a picking robot works



Flowchart of how the force sensor works

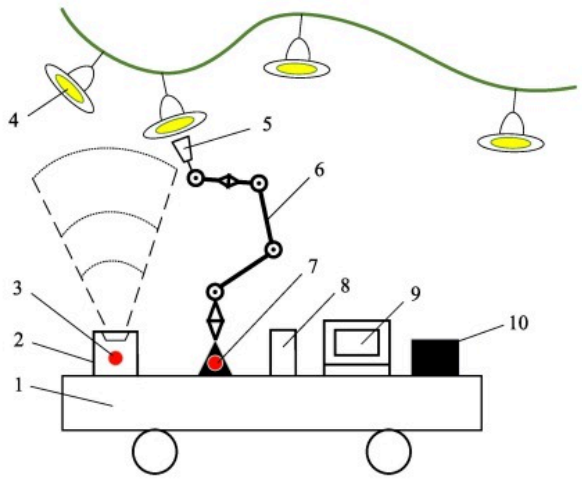

Start
Scheduled work track travel
Stop at the first stop point
Binocular vision
Image processing
Extract maximum target information
Calculate space coordinates
Send target information to the robotic arm control system
"Global" vision servo control
Replanning the trajectory
Does the force-sensing system detect an impact force greater than a threshold?
Yes
No
Robotic arm moves to a fixed distance from the target
Is the ratio ρ of the target pixel area to the total image pixel area in the monocular vision image 5%-75%?
No
Monocular vision
Yes
Image processing
Calculate the longitudinal deviation Δy, lateral deviation Δx, and ρ of the target compared to the image center point
Send target information to the robotic arm control system
"Local" vision servo control
Replanning the trajectory
Does the force-sensing system detect an impact force greater than a threshold?
Yes
No
Δx<2.5mm?
Δy<2.5mm?
ρ >98%?
No
Yes
Robotic arm for fruit picking
Current space job terminated?
No
Yes
Move to next stop point
No
Picking job terminated?
Yes
End

	Flowchart demonstrating system used by robot to pick a tomato  The completed arm *There are also multiple videos of the arm moving at the bottom of the paper that I couldn't put here.*
VOCAB: (w/definition)	Binocular Vision System: Collects data on locations of fruit in trees in a wide area Monocular Vision System: Collects data in a small area from the claw and moves slowly, but accurately
Cited references to follow up on	Arad et al., 2020 B. Arad, J. Balendonck, R. Barth, O. Ben-Shahar, Y. Edan, T. Hellstrom, J. Hemming, P. Kurtser, O. Ringdahl, T. Tielen, B. van Tuijl Development of a sweet pepper harvesting robot J. Field Rob., 37 (6) (2020), pp. 1027-1039, 10.1002/rob.21937 Chen et al., 2018 S.X. Chen, M.Z. Luo, F. He A universal algorithm for sensorless collision detection of robot actuator faults Adv. Mech. Eng., 10 (1) (2018), 10.1177/1687814017740710
Follow up Questions	● What does the robot do with the picked tomatoes? ● How was the robot designed to not hurt humans when it runs into them? The emergency stop is based off of the robot hitting someone with a certain force, so how will the person not be hurt by something other than that force? ● What will technology like this mean for jobs in the future? Is there a risk that humans in these positions will be replaced? ● How was the 3D printing filament chosen?

Article #10 Notes: Design of a lightweight robotic arm for kiwifruit production

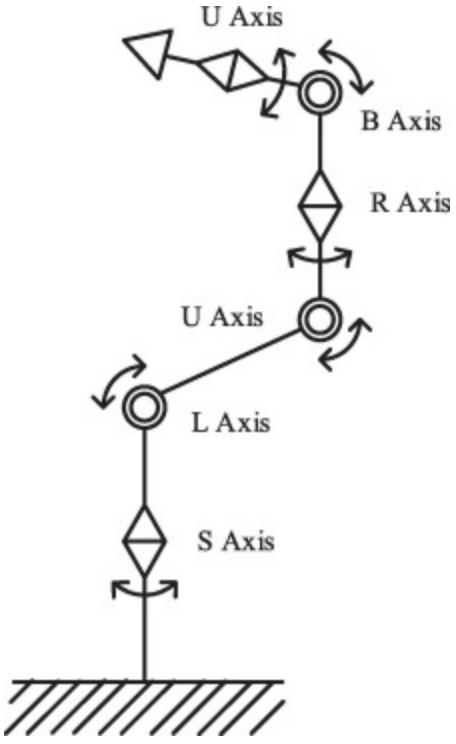
Source Title	Computers and Electronics in Agriculture
Source citation (APA Format)	Li, K., Huo, Y., Liu, Y., Shi, Y., He, Z., & Cui, Y. (2022). Design of a lightweight robotic arm for kiwifruit pollination. *Computers and Electronics in Agriculture*, *198*, 107114. https://doi.org/10.1016/j.compag.2022.107114
Original URL	https://doi.org/10.1016/j.compag.2022.107114
Source type	Journal Article
Keywords	6 DOF, Binocular
#Tags	#arm #fruit
Summary of key points + notes (include methodology)	This robot was made with carbon fiber tubes and 3D printed joints made of nylon 6. Strength simulations were performed on the 3D printed parts of the robot before it was assembled and nylon 6 was found to be strong enough. Because of the materials used, the robot was sufficiently light and inexpensive. The tobot uses a binocular camera to scan for flowers to pollinate and an atomiser to disperse the pollen. The binocular camera was installed on the base because it only needed to look above the robot. The robotic arm was controlled with an IPC, motion controller, six stepper motors, and six motor drivers. This robot cost around 1,086 USD to build, which is pretty inexpensive in the grand scheme of robotic arms. The arm is also able to move very smoothly because of a polynomic model made using MATLAB and can start and stop very quickly.
Research Question/Problem/ Need	The kiwi farming industry in China recently received a lot of land, but a lack of pollinators makes it difficult to pollinate each plant.

Important Figures	

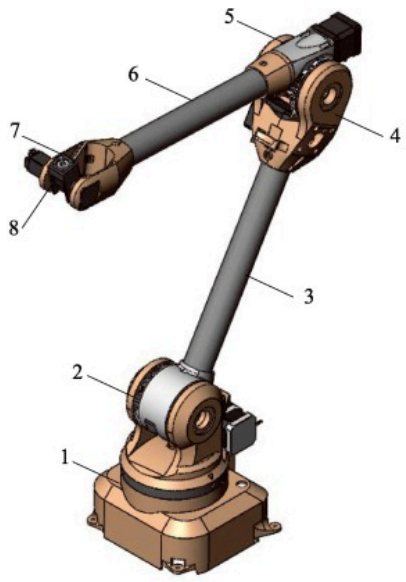


1. Chassis; 2. binocular vision system; 3. camera's origin of coordinates; 4. flower; 5. sprayer; 6. mechanical arm; 7. base coordinate origin; 8. pollen pot; 9. target identification processor; 10. main controller

The basic design of the robotic arm and other components

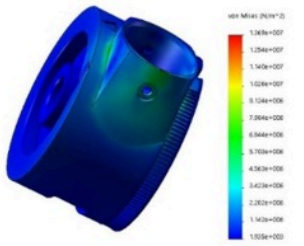


Schematic of robotic arm

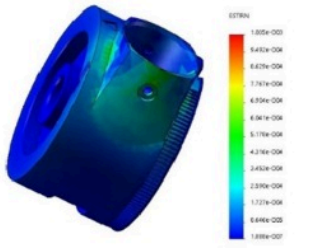


1. Waist joint; 2. shoulder joint; 3. upper arm; 4. elbow joint; 5. yaw joint at the wrist; 6. forearm; 7. pitching joint at the wrist; 8. rolling joint at the wrist

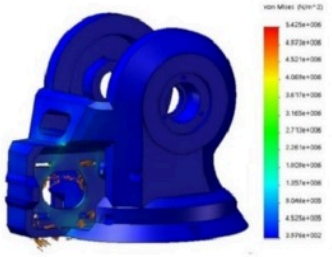
Three dimensional model of the robotic arm



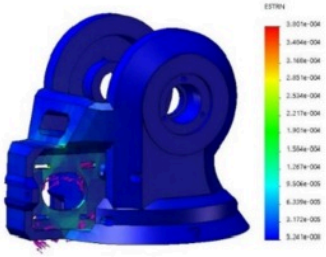
(a) Stress diagram of the shoulder rotating parts



(a) Strain diagram of the shoulder rotating parts

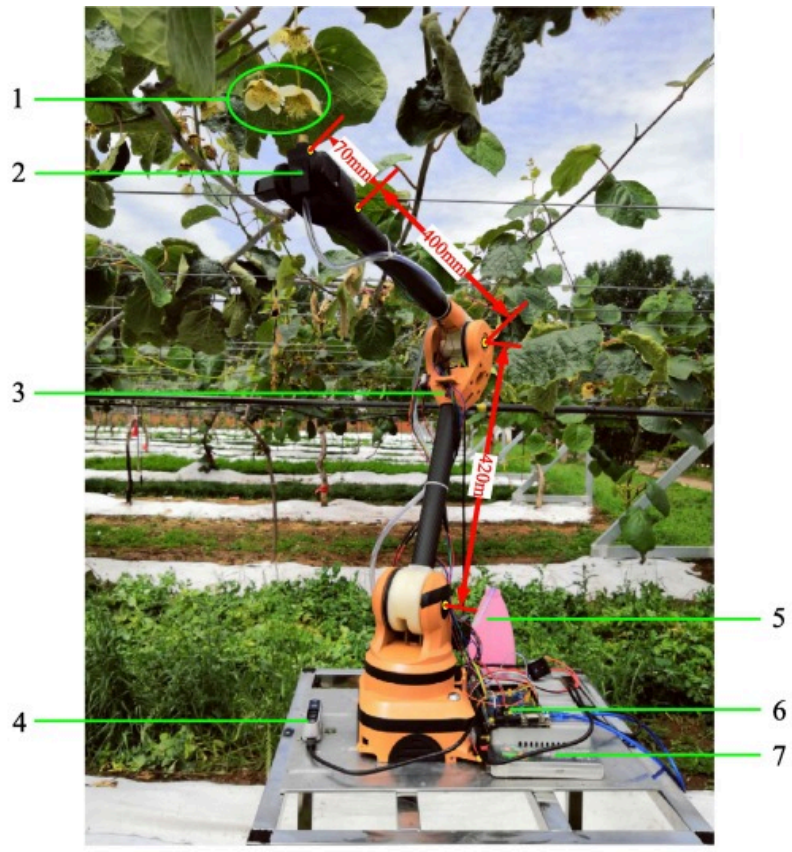


(a) Stress diagram of the shoulder supports



(a) Strain diagram of the shoulder supports

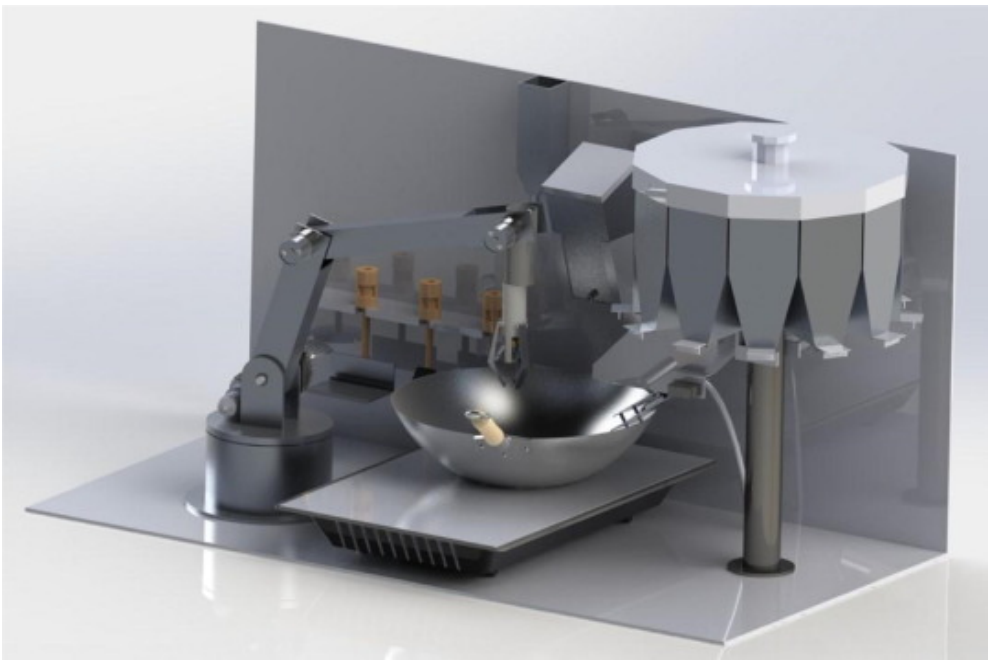
The results of the stress and strain simulations

	 1. Kiwifruit flowers to be pollinated; 2. end executor (sprayer); 3. lightweight robotic arm; 4. binocular camera; 5. pollen pot; 6. master controller; 7. IPC The assembled robot
VOCAB: (w/definition)	Atomiser: The type of bottle that sprays perfume
Cited references to follow up on	None, most sources referred to kiwi pollination or other agricultural information and not to the design and development of robotic arms.
Follow up Questions	• Could this robotic arm also work with a microcontroller? • If not, why does it require an IPC?

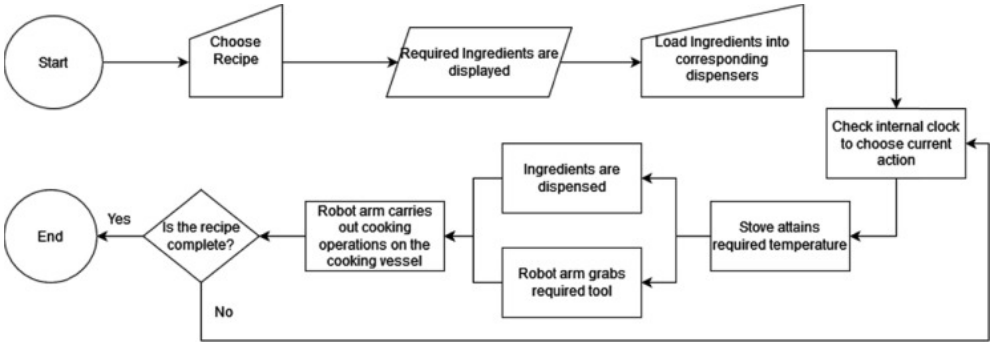
Article #11 Notes: Design of a robotic arm for domestic culinary assistance

Source Title	Materials Today
Source citation (APA Format)	Mepani, M. M., Gala, K. B., Mishra, T. A., Suresh Bhole, K., Gholave, J., & Daingade, S. (2022). Design of robot arm for domestic culinary assistance. *Materials Today: Proceedings*, *68*, 1930–1945. https://doi.org/10.1016/j.matpr.2022.08.140
Original URL	https://doi-org.ezpv7-web-p-u01.wpi.edu/10.1016/j.matpr.2022.08.140
Source type	Journal Article
Keywords	Arm, Claw
#Tags	#arm #claw
Summary of key points + notes (include methodology)	This device was designed to be able to cook three foods: bhindi masala, pav bhaji, and dosa. These dishes require chopping, stirring, folding, mixing, and dispensing dough. The first step in using the device is selecting one of the three foods. Next, the user has to put in the ingredients, although the device is capable of measuring them. There are three parts of the device that the ingredients go through. Solid ingredients go through the solid ingredient dispenser, which is capable of measuring them and then putting them into a slot to be deposited in the pan at the proper time. There is also an oil dispenser and a dispenser for dosa batter. The pan sits atop a stove and there is a 5 DOF arm that uses different tools. By running simulations with ANSYS software, the engineering team was able to determine that aluminum was the best material for the device. The team used weight, cost, and heat resistance in their decisions. The team saw that both nylon and aluminum would work for their purposes, with nylon working best for their original design. However, due to the high price of nylon, they decided to use a thinner joint made of aluminum. By slightly changing the design of their arm, the cost of creating a prototype robot was significantly reduced.
Research Question/Problem/ Need	How can a robotic arm be developed to cook specific dishes in a standard household?

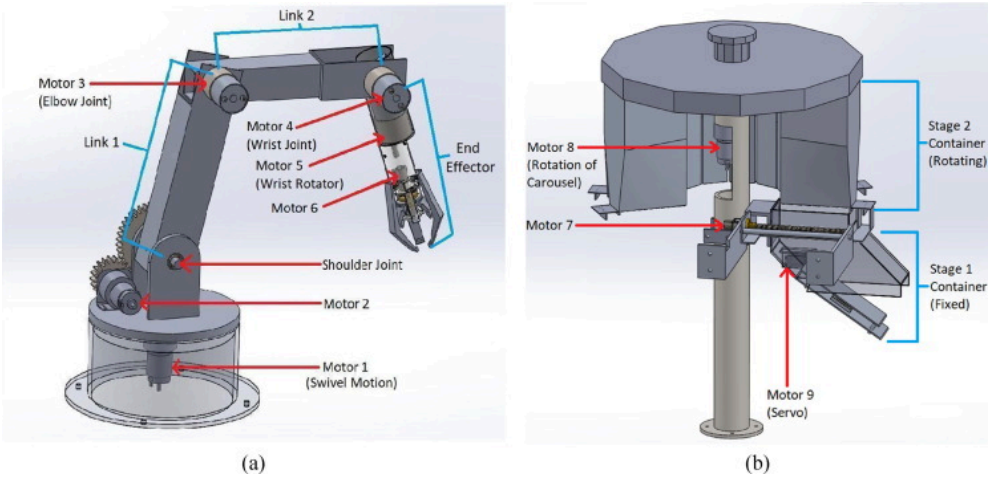
Important Figures



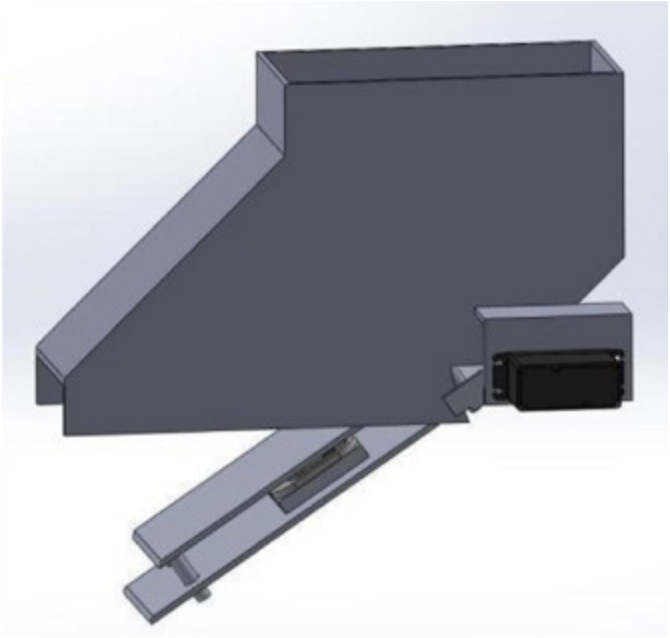
CAD model of device



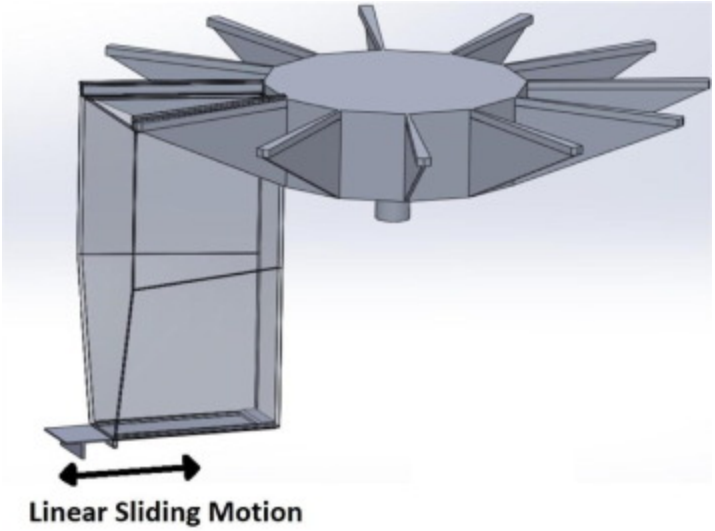
Flowchart of cooking process



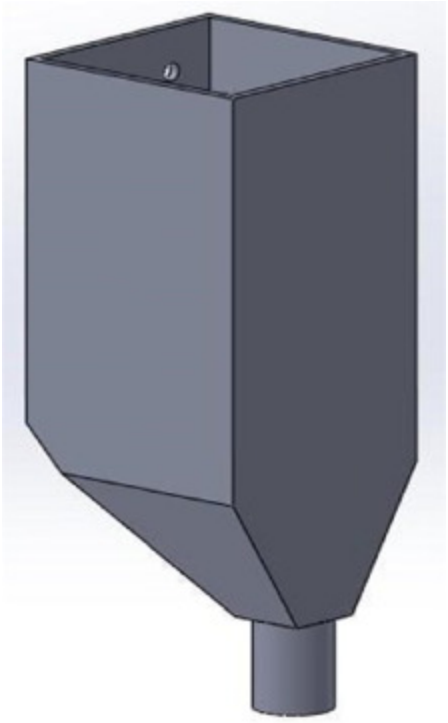
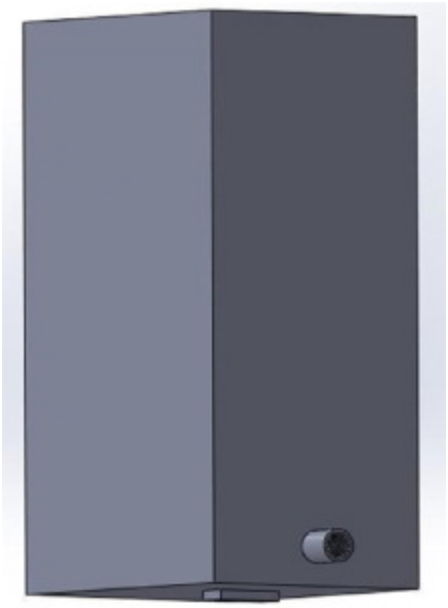
The robotic arm designed and the solid food dispenser (a and b, respectively)



The solid food dispenser, stage one



The solid food dispenser, stage two

	 The oil dispenser  The dosa batter dispenser
VOCAB: (w/definition)	Simulated Annealing: A strategy used for optimization problems, either unconstrained or bound constrained.
Cited references to follow up on	M.E. Moran Evolution of robotic arms J. Rob. Surg., 1 (2) (2007), pp. 103-111

Follow up Questions	● Can the recipes be changed (for example, would I be able to customize the spice ratio in the bhindi masala)? ● How easy is it to clean this device? It was designed for domestic use, but doesn't look like it would come apart easily and might develop mold. ● Does it really save a lot of time? Ingredients still have to be added pretty frequently. ● How was the robot able to pick the tools up? What went into picking the shape of the claw?

Article #12 Notes: Advances in Online Handwritten Recognition in the Last Decades

Source Title	Computer Science Review
Source citation (APA Format)	Ghosh, T., Sen, S., Obaidullah, Sk. Md., Santosh, K. C., Roy, K., & Pal, U. (2022). Advances in online handwritten recognition in the last decades. *Computer Science Review*, *46*, 100515. https://doi.org/10.1016/j.cosrev.2022.100515
Original URL	https://doi.org/10.1016/j.cosrev.2022.100515
Source type	Review Article
Keywords	OCR
#Tags	#OCR
Summary of key points + notes (include methodology)	This article outlines different types of handwriting recognition. I think that handwriting recognition technology would apply to the problem of identifying text on the spines of books because there are a variety of fonts used on books. The steps of a handwriting recognition system are: data acquisition, pre-processing, segmentation, feature extraction, classification, and post-processing. Data acquisition refers to the creation of a dataset to be used by the recognition system. Pre-processing is used for neatening the data. Segmentation breaks the data down into distinct parts. Feature extraction is when the key features of a letter are sussed out. The letter is classified in the classification stage and then the result is checked in post-processing.
Research Question/Problem/ Need	It's necessary to digitize written text so that it's not lost to time. This can be done in a variety of ways.
Important Figures	 The system used by the recognition software to identify a letter
VOCAB: (w/definition)	Offline Handwriting Recognition: Text is recognized in an image Online Handwriting Recognition: Text is recognized in real time Optimal Character Recognition (OCR): The process of recognizing text letter-by-letter

Cited references to follow up on	Lee J.J., Kim J.H., Nakajima M. A hierarchical HMM network-based approach for on-line recognition of multi-lingual cursive handwritings IEICE Trans. Inf. Syst., 81 (8) (1998), pp. 881-888
Follow up Questions	● The paper mentions several times that OCR technology has been used to identify information about the writer, such as gender. What tests have been done to prove that there is a strong enough correlation to make a decision this way? ● Is OCR able to identify text in one part of an image, while ignoring the others?

Article #13 Notes: Development of OCR System on Android Platforms to Aid Reading With a Refreshable Braille Display in Real Time

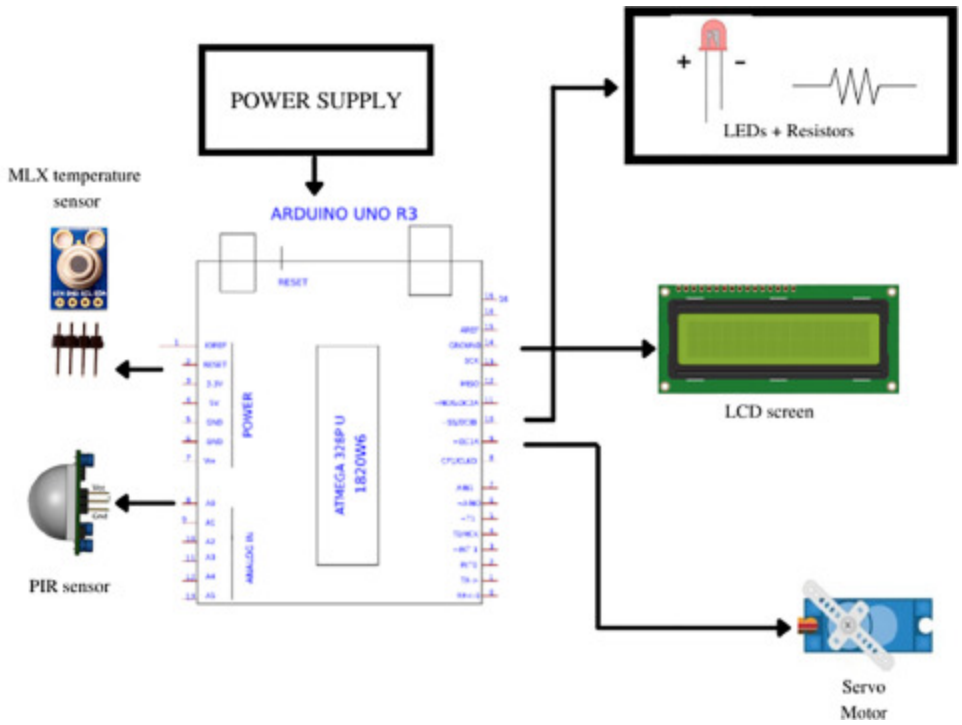
Source Title	Measurement
Source citation (APA Format)	Holanda, G. B., Souza, J. W. M., Lima, D. A., Marinho, L. B., Girão, A. M., Bezerra Frota, J. B., & Rebouças Filho, P. P. (2018). Development of OCR system on android platforms to aid reading with a refreshable braille display in real time. *Measurement*, *120*, 150–168. https://doi.org/10.1016/j.measurement.2018.02.021
Original URL	https://doi.org/10.1016/j.measurement.2018.02.021
Source type	Research Article
Keywords	OCR, Tesseract
#Tags	#OCR, #Tesseract
Summary of key points + notes (include methodology)	Many blind and visually impaired people suffer from the lack of books in braille. This lack leads to social isolation and intellectual boredom. In order to combat this, many devices have been designed that use OCR to convert written text to audio or braille. This study presents another device, designed with children in mind. The device employs OCR, image preprocessing, and segmentation. Image preprocessing involves removing “background noise” in the image (in this study by using a Gaussian equation) to make it easier to identify text. Segmentation can be done in many different ways. The four methods of segmentation used in this device are Region Growing, Watershed, Connected Objects, and Connected Contours. In order to assess the specificity of the device, the engineers used the equation (TN)/(TN + FP). To calculate sensitivity, they used (TP)/(TP + FN). Positive Predictive Value was found with (TP)/(TP + FP). The F-score was calculated by finding the harmonic mean between the sensitivity and PPV ((2 * (Sensitivity * PPV)/(Sensitivity + PPV). F-scores are used to assess the accuracy of a test when there is a difference in the amount of data collected for different parts of the experiment. Generally, a good F score is above 0.7.

Research Question/Problem/ Need	It's necessary to digitize written text so that it's not lost to time. This can be done in a variety of ways.
Important Figures	The authors did not include figures, which may have made it easier to make sure that I understood exactly what they were doing.
VOCAB: (w/definition)	Connected Contours: A segmentation method that looks for the outline of the segment instead of finding the space inside of it Connected Objects: A method for segmentation that looks for pixels similar to the ones nearby and identifies boundaries where the similarities end Offline Handwriting Recognition: Text is recognized in an image Online Handwriting Recognition: Text is recognized in real time Optimal Character Recognition (OCR): The process of recognizing text letter-by-letter Positive Predictive Value (PPV): The number of cases correctly identified as positive out of the number of cases identified as positive Region Growing: A method of segmentation that starts with one pixel and checks the others as it spirals out Watershed: The watershed method of segmentation looks at a 3D rendering of an image and identifies contours where there are valleys in the image. These contours become the outlines of segments
Cited references to follow up on	
Follow up Questions	● Are aspects outside of the braille accessible to visually impaired people? Is it easy to set up without being able to see? ● How is this better than other devices on the market? It sounds very similar. ● Has this device actually been used?

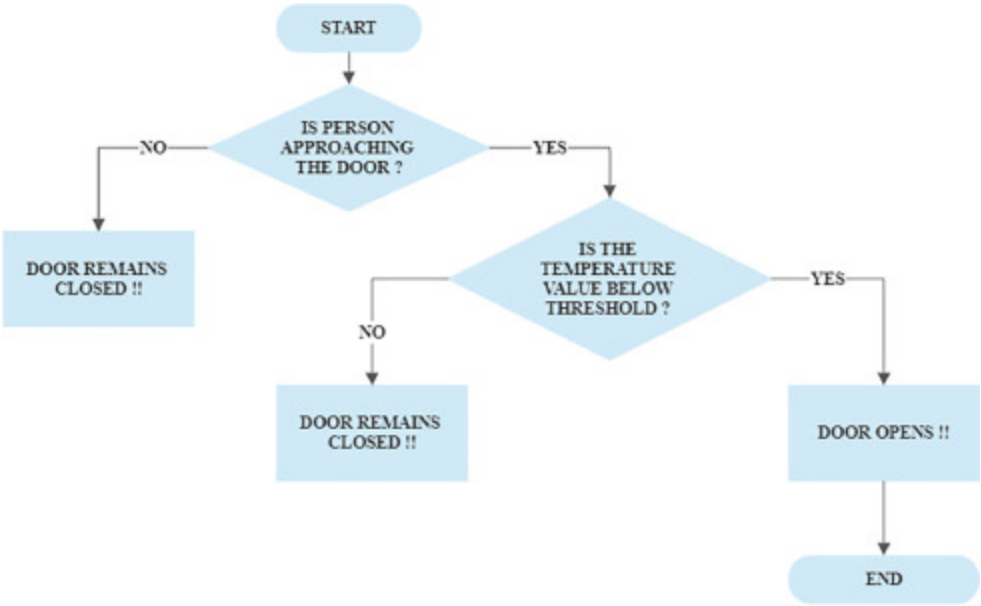
Article #14 Notes: Smart Automatic COVID Door Opening System With Contactless Temperature Sensing

Source Title	Advances in Electrical Engineering, Electronics and Energy
Source citation (APA Format)	**Venkataramanan, V., Shah, D., Panda, I., Shah, S., Davawala, R., Shah, K., & Salot, K. (2023). Smart automatic COVID door opening system with contactless temperature sensing. *E-Prime - Advances in Electrical Engineering, Electronics and Energy*, *6*, 100284. https://doi.org/10.1016/j.prime.2023.100284**
Original URL	https://doi-org.ezpv7-web-p-u01.wpi.edu/10.1016/j.prime.2023.100284
Source type	Journal Article
Keywords	Arduino UNO, Servo
#Tags	#ArduinoUNO, #Servo
Summary of key points + notes (include methodology)	In order to reduce the risk of spreading COVID-19, Venkataramanan et al. designed a system that opens a door when human body temperature below a limit is detected near the knob. The device goes over a doorknob and can detect how far away an approaching person is, what their body temperature is, and whether or not they're wearing a mask. The passive infrared (PIR) sensor detects distance from the door and the MLX temperature sensor takes the person's temperature. If the person is detected as having a fever, the LED flashes and the screen alerts the person and the door remains closed. If the person is not detected as having a fever, the door remains closed. The sensors and motor are connected to the Arduino UNO's ports. The power supply of the Arduino was not specified.
Research Question/Problem/ Need	Many public spaces have people taking patrons' temperatures as a measure against COVID-19. This risks exposing that person to the virus.

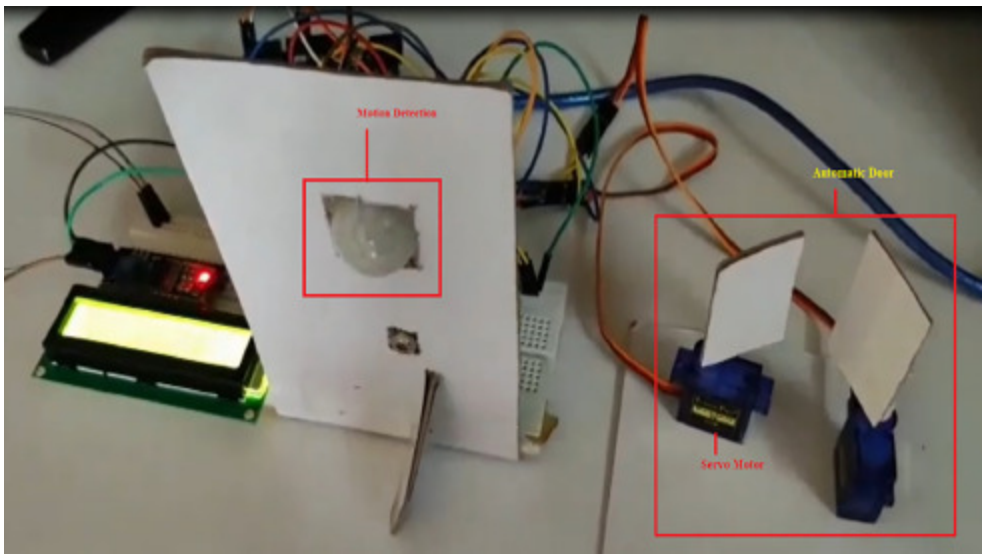
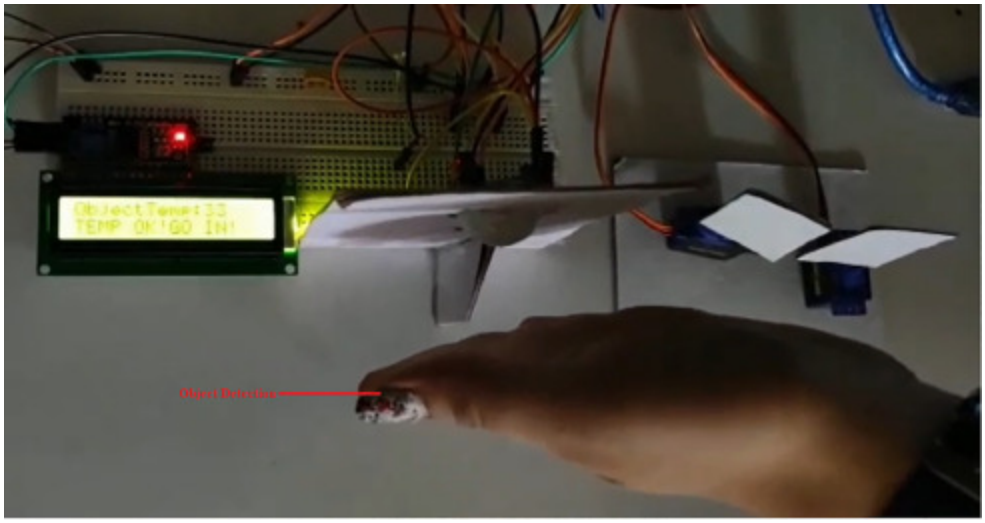
Important Figures



A block diagram of the system used by the robot. Basically, it detects a person and takes their temperature with the PIR and MLX temperature sensors, then decides whether or not to open the door, displays its decision, and opens it (if it decides to) using the servo motor.



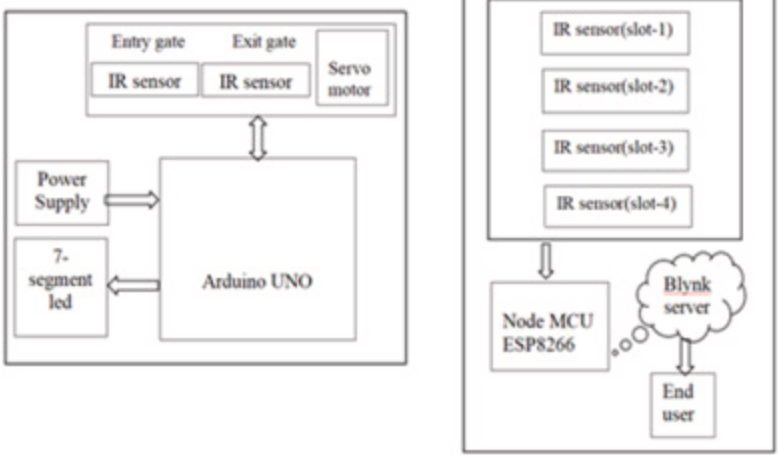
A flowchart explaining the device's process

	  The above two images show the same prototype. This is the device with all of the sensors and displays attached. The lower image shows how the device would actually work.
VOCAB: (w/definition)	Passive Infrared (PIR) Sensor: Measures infrared light of nearby objects
Cited references to follow up on	
Follow up Questions	• Can you still lock the door? • What if someone is sick and needs help? They wouldn't be able to alert anyone and they could have something serious. • There are people that aren't able to wear a mask for medical reasons (respiratory diseases, under two years old, etc.). These also tend to be the people that suffer the most because of COVID-19 infections and are people that this device is trying to protect. Is there a way to make this device so that these people can still access public spaces? • How does the servo motor open the door? Does it turn the handle or has

	the handle completely left the picture?

Article #15 Notes: IoT Based Smart Packing Model Using Arduino UNO With FCFS Priority Scheduling

Source Title	Measurement: Sensors
Source citation (APA Format)	**Veeramanickam, M. R. M., Venkatesh, B., Bewoor, L. A., Bhowte, Y. W., Moholkar, K., & Bangare, J. L. (2022). IoT based smart parking model using Arduino UNO with FCFS priority scheduling. *Measurement: Sensors*, *24*, 100524. https://doi.org/10.1016/j.measen.2022.100524**
Original URL	https://doi-org.ezpv7-web-p-u01.wpi.edu/10.1016/j.measen.2022.100524
Source type	Research Article
Keywords	Arduino UNO
#Tags	#Arduino UNO
Summary of key points + notes (include methodology)	The program used to track parking spots utilizes ultrasonic sensors to identify open slots and recommends spots based on a first come first serve algorithm. This type of technology is expected to become more in-demand. The model created was successful, and was able to handle over 180 different scenarios at the annual peak in parking. People looking for parking are presented with an LED display of available parking spots (each spot has a number).
Research Question/Problem/ Need	In many cities, especially in India, parking is hard to come by. People don't know where space is available and it slows traffic.

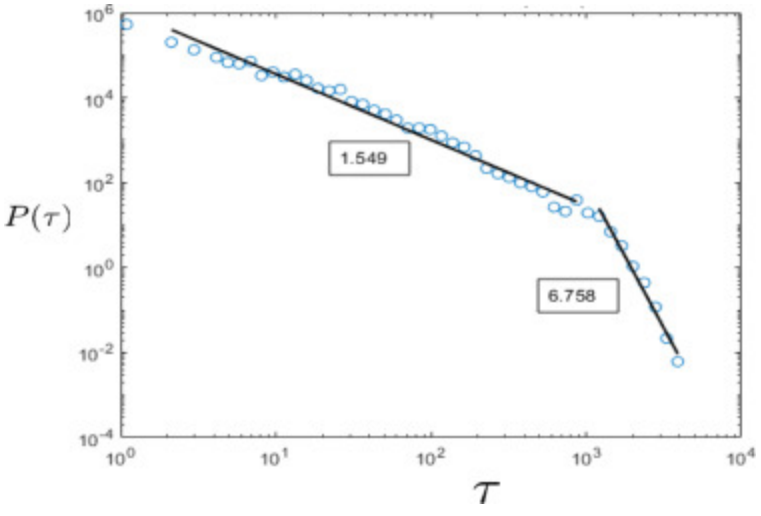
Important Figures	 A block diagram of the system. The Arduino UNO communicates with IR sensors to detect cards and then a Blynk server sends information on available slots to the driver.
VOCAB: (w/definition)	Internet of Things (IoT): A system of connecting parts of a system using the internet
Cited references to follow up on	
Follow up Questions	• Does the functionality of the device at peak driving times mean that it is also good for normal times?

Article #16 Notes: Book Recommendation Based on Library Loan Records and Bibliographic Information

Source Title	Social and Behavioral Sciences
Source citation (APA Format)	Tsuji, K., Takizawa, N., Sato, S., Ikeuchi, U., Ikeuchi, A., Yoshikane, F., & Itsumura, H. (2014). Book recommendation based on library loan records and bibliographic information. *Procedia - Social and Behavioral Sciences*, *147*, 478–486. https://doi.org/10.1016/j.sbspro.2014.07.142
Original URL	https://doi-org.ezpv7-web-p-u01.wpi.edu/10.1016/j.sbspro.2014.07.142
Source type	Research Article
Keywords	Book, Library, Library System
#Tags	#Book, #Library, #LibrarySystem
Summary of key points + notes (include methodology)	This book recommendation system uses data beyond simple loan records to recommend books using a machine learning model. The model looks at categories of book that the patron has enjoyed and summaries. Subjects were asked for one book that they were currently interested in and then given books recommended in a variety of ways, including by Amazon. Participants then scored the books they were given based on the same scale as the book that they said they were interested in. The books identified initially as of interest by the participants were plotted based on title (unique words and strings of words contained in the title were used) and then books to be recommended were scored based on their similarity to that title. The six most similar books were recommended. The program also looks at groups of books commonly checked out together and gives special preference to books associated with an already-selected book for recommendation. The most effective metrics were title and loan record, but they still were not rated as highly as Amazon's program.
Research Question/Problem/ Need	Library patrons often have trouble finding a book that they're interested in.
Important Figures	There were no figures included in the paper that I could see. The paper was a small pdf and I couldn't zoom in enough to read the tables.
VOCAB: (w/definition)	

Cited references to follow up on	
Follow up Questions	● Would taking information about the reader into account improve the accuracy of book assignation (you don't want to recommend *War and Peace* to a five-year-old because the system saw that they liked *Fancy Nancy* and therefore stories about extravagance)? ● How does this system adhere to library privacy policies? ● Does using only people from one major limit the number of scenarios that were able to be tested? 32 people interested in library science (a small department) likely already know each other and recommend each other books, so their data might be similar. ● A lot of people like to read to expand their perspectives. How could that be incorporated into this system so that people don't have to keep reading the same thing?

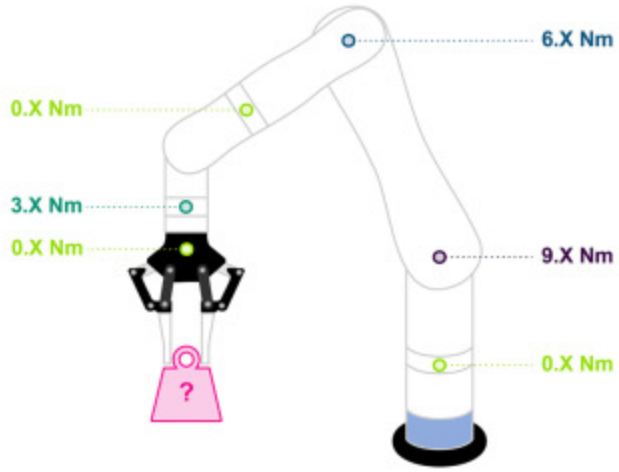
Article #17 Notes: Self-Organized Human Behavioral Patterns in Book Loans From a Library

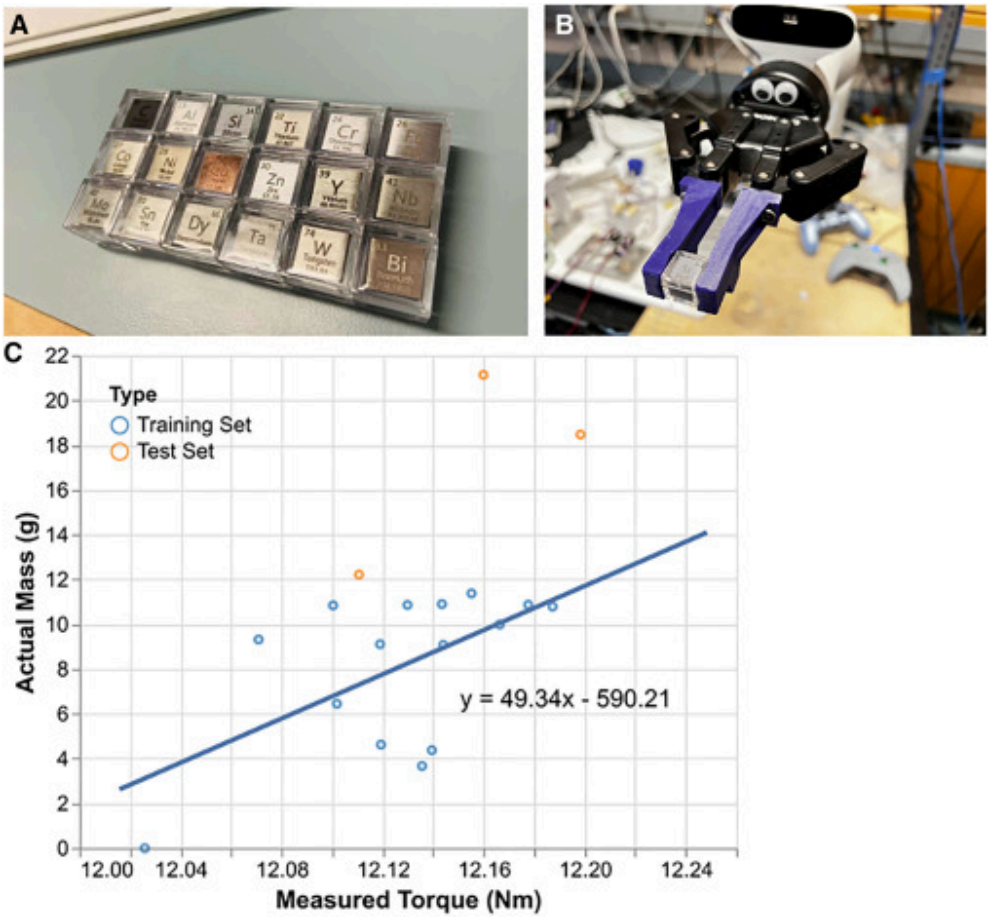
Source Title	Statistical Mechanics and its Applications
Source citation (APA Format)	Lee, T. H., & Lee, J. W. (2021). Self-organized human behavioral patterns in book loans from a library. *Physica A: Statistical Mechanics and Its Applications*, *563*, 125473. https://doi.org/10.1016/j.physa.2020.125473
Original URL	https://doi-org.ezpv7-web-p-u01.wpi.edu/10.1016/j.physa.2020.125473
Source type	Research Article
Keywords	Library Systems
#Tags	#LibrarySystems
Summary of key points + notes (include methodology)	In order to compare times that library books were returned, the researchers used prioritization algorithms to create a power law distribution of book borrowing frequency. They observed that borrowing rates go down as the year progresses. It has also been decreasing overall since 2005, as the internet became more popular. The return rate reaches a power law distribution once the due ddate has passed, but is pretty random until then.
Research Question/Problem/ Need	Understanding behavior around when people return library books (before vs after the due date) is important to improving return rates.
Important Figures	

	In this graph, τ is the time (units not specified) between taking out and returning a book and *P* is the probability of th ebook being returned. The book becomes much less likely to be returned after τ hits 1,000.
VOCAB: (w/definition)	Power Law Distribution: A relationship in which one thing happening directly impacts another thing happening
Cited references to follow up on	
Follow up Questions	● How did the researchers get permission to use library data? ● How was the data kept anonymous?

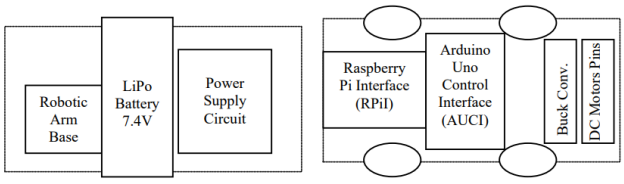
Article #18 Notes: Training a Robotic Arm to Estimate the Weight of a Suspended Object

Source Title	Device
Source citation (APA Format)	Yang, F., & Hein, J. E. (2023). Training a robotic arm to estimate the weight of a suspended object. *Device*, *1*(1), 100011. https://doi.org/10.1016/j.device.2023.100011
Original URL	https://doi-org.ezpv7-web-p-u01.wpi.edu/10.1016/j.device.2023.100011
Source type	Research Article
Keywords	Robotic Arm, Weight
#Tags	#RobotArm, #Weight
Summary of key points + notes (include methodology)	Robotic arms are used a lot in laboratory settings. It is rare that someone there would have the necessary coding background to do sophisticated tasks with the robot. The paper details the use of a simple machine learning-based approach to use a robotic arm to measure density that is accessible to someone with less experience. First, they compared the torque on the motors and the masses of the objects. Then, they used that information to analyze the torque with a machine learning algorithm developed based on this relationship. The program was able to estimate mass with 0.1 gram accuracy.
Research Question/Problem/ Need	How can torque be used to efficiently calculate the weight of an object?

Important Figures	 The graphical abstract

	 The pure element cubes of different masses held by the robot (a). The robot holding a cube (b). A graph relating the measured torque and actual mass (c) that shows a line of best fit with a decent number of outliers.
VOCAB: (w/definition)	
Cited references to follow up on	
Follow up Questions	• Was this program made by someone with less coding experience? • Have labs used Scikit-Learn in the past?

Article #19 Notes: Mobile Robot Platform with Arduino Uno and Raspberry Pi for Autonomous Navigation

Source Title	Procedia Manufacturing
Source citation (APA Format)	Oltean, S.-E. (2019). Mobile robot platform with Arduino Uno and Raspberry Pi for autonomous navigation. *Procedia Manufacturing*, *32*, 572–577. https://doi.org/10.1016/j.promfg.2019.02.254
Original URL	https://doi-org.ezpv7-web-p-u01.wpi.edu/10.1016/j.promfg.2019.02.254
Source type	Research Article
Keywords	Arduino Uno, Raspberry Pi
#Tags	#ArduinoUno, #RaspberryPi
Summary of key points + notes (include methodology)	A robot was designed that rolls around with a simple arm attached on top. The arm motors and camera are controlled by a Raspberry Pi and the sensors and wheels are controlled by an Arduino Uno. The Pi sends codes (44, 55, 66, etc.) to the Arduino that tell it to execute a specific program. The Arduino was programmed with the Arduino IDE and the Pi with C/C++.
Research Question/Problem/ Need	How can a low cost robot be developed with an Arduino Uno and Raspberry Pi?
Important Figures	 A diagram of the robot to be designed
VOCAB: (w/definition)	
Cited references to follow up on	
Follow up Questions	• In what format did the Raspberry Pi return information that it was readable by the Arduino? Can you simply have it spit out a serial input? I know that it works exactly like if there was a computer plugged into the Arduino, so I would assume so.

Article #20 Notes: Smart Real Time Health Monitoring System Using Arduino Uno and Raspberry Pi

Source Title	Materials Today
Source citation (APA Format)	Bora, P., Kanakaraja, P., Chiranjeevi, B., Jyothi Sri Sai, M., & Jeswanth, A. (2021). Smart real time health monitoring system using Arduino and Raspberry Pi. *Materials Today: Proceedings*, *46*, 3855–3859. https://doi.org/10.1016/j.matpr.2021.02.290
Original URL	https://doi-org.ezpv7-web-p-u01.wpi.edu/10.1016/j.matpr.2021.02.290
Source type	Research Article
Keywords	Arduino Uno, Raspberry Pi
#Tags	#ArduinoUno, #RaspberryPi
Summary of key points + notes (include methodology)	This article explains the electronics of an Arduino-Raspberry Pi system to monitor heartbeat, body temperature, and heart rhythm and electrical activity. Various sensors are attached to the Arduino Uno. The Arduino Uno, programmed in the Arduino IDE, sends that information to the Raspberry Pi. The Raspberry Pi is an interface between the Arduino and the doctors. Once it receives the data, the Pi uploads it to a website accessible by doctors, patients, and families. The device can also be used to send an SMS alert when the patient feels poor or a problem is detected.
Research Question/Problem/ Need	Older people are susceptible to many health conditions and therefore require an accurate health monitoring system.
Important Figures	No figures were included with this study that are relevant to the information I'm looking for.
VOCAB: (w/definition)	
Cited references to follow up on	
Follow up Questions	• Why does the study identify old people in particular? It seems that it would be useful for anyone with medical problems. Are old people just most of people with medical problems? • Is this device more useful for when patients are sent home from the

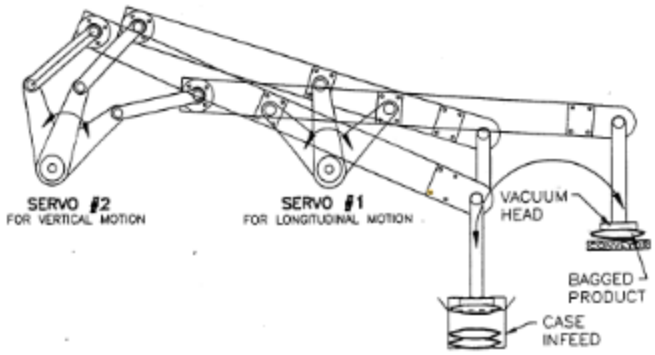
	hospital but still require medical monitoring? It seems that it would be good for reducing the price of hospital stays by getting people out faster. ● Is it legal to put medical information like that on a platform accessible by the patient's family? I think that that has to stay between patient and doctor.

Patent #2 Notes: Microcontroller Based Robotic Arm Development for Library Management System

Source Title	Cornell University
Source citation (APA Format)	Barma, B. (n.d.). *Microcontroller based robotic arm development for library management system*. https://arxiv.org/abs/1812.11316
Original URL	https://arxiv.org/abs/1812.11316
Source type	Patent
Keywords	Arm, Library, Patent
#Tags	#Arm, #Library, #Patent
Summary of key points + notes (include methodology)	The robot described in this patent can carry out a variety of tasks necessary in a library. It can check books in and out and retrieve them based on user input. It does not need to make sure that they are in the right order because it replaces librarians, so all of the books were placed there by the robot. It runs on two Arduinos, one of them receives information from an app on a library patron's phone on which book should be retrieved. The other controls the arm and retrieves the book. The device requires installation in the roof or on the ground. The device and installation costs are high, but because of the number of librarians that can be fired with this technology, it becomes cheaper to use a system of these robots.
Research Question/Problem/ Need	Libraries require organization so that books don't become unfindable.
Important Figures	There were no important figures included in this patent.
VOCAB: (w/definition)	
Cited references to follow up on	
Follow up Questions	• People like libraries for reasons beyond the fact that they can check out books. Many people read and study in libraries and a lot of libraries have puzzles and other games that create a nice environment for their patrons. Would this device interrupt that environment? • Libraries that buy this device would probably need to fire a lot of librarians. How would things that librarians spend a lot (but not most of) their time on, like recommending books and helping navigate other public

	services, be maintained if they’re gone?

Patent #3 Notes: Robotic Arm for Handling Product

Source Title	Google Scholar
Source citation (APA Format)	Fallas, D. (expired - lifetime). *Robotic arm for handling product* (Patent US5326218A). https://patents.google.com/patent/US5326218A/en
Original URL	https://patents.google.com/patent/US5326218A/en
Source type	Patent
Keywords	Robot Arm
#Tags	#RobotArm
Summary of key points + notes (include methodology)	The robotic arm described in this patent is to be used for moving products into shipping boxes. There is a shaft on a main part of the device. That shaft can rotate on an axis (not the main part). There is also an arm rotating around the shaft and rotates around the part that is not covered by the shaft. The arm is controlled with a servo motor. Because there's only one shaft, the programming of the device is very simple.
Research Question/Problem/ Need	How can a robotic arm be used to move products in a factory?
Important Figures	 A drawing of the arm
VOCAB: (w/definition)	
Cited references to follow up on	

Follow up Questions	● How have industrial robots changed since this device was invented? ● What kind of testing was done on this device? ● What is the disadvantage of using just one driven shaft?