ISSN (Online) 2395-2717

International Journal of Engineering Research in Electrical and Electronic Engineering (IJEREEE)

Vol 12, Issue 01, January 2025

Automatic Ice-cream Scooper

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Abstract*— The Automatic ice cream scooper is designed to make a scoop of ice-cream in an easy way. The development of this prototype is mainly for ice-cream shop that helps users to scoop the ice cream with minimal effort. It come with a heated scooping mechanism that cuts the ice cream even the hardest ice cream effortlessly and producing perfectly shaped scoops every time. The model include features like adjustable portion control when the first layer of ice cream got emptied and ergonomic designs for comfortable use. The main method was that we used thermocouple for accurate measuring the temperature of the ice-cream without interfering with its texture or consistency. And Implemented safe features such as thermal cutoff switches to prevent overheating. For adjustable portion control rack and pinion mechanism is used. Then the robotic arm actuated with servo motor was controlled by Arduino UNO was programmed to scoop Ice-cream. The outcome of the design is simplified and enhance the process of scooping and serving ice-cream. Its provide the convenient, efficient and user-friendly solution, reducing physical effort and time required compared to normal scooping methods. This model is developed for commercial establish, easy usage and potentially incorporating innovative features to improve ice-cream scooping experience. This work may solve the problem that the scooping ice-cream shop employees need to be supported by the technology in their hard work and to improve the efficiency of the ice-cream.

***Index Terms*— Adjustable portion control, Heated scooping mechanism, rack and pinion mechanism Thermal cut-off switches.**

I. INTRODUCTION

Now-a-days, Demand is increasing as more people chose ice-cream as their post-meal treat. By FY25, the Indian market for products made from milk or cream with sweeteners and taste like fruit and cocoa is expected to grow to over USD 5 billion thanks to the rise of both indigenous and foreign brands. The first vending machine designs were costs while meeting growing consumer demand. First we decide to design a vending ice-cream Machine. However, according to some relative work, there have some same kind of ice-cream machines that have been designed for family or a small part of customers, we designed a machine all these products are ***lower than the whole set up of vending machine***. So, our second thought is to design an automatic scooper machine which provides various tastes of ice-cream in ***easy manner and in low cost.***

II. PROPOSED SOLUTION

The automated ice cream scooper for retail spaces uses a two-link manipulator and Arduino programming to remove the need for human intervention. The servo motor rotates to effectively scoop after a brief activation of a DC gear motor. The DC gear motor takes a while to return the scooper to its original position. Prior to deactivation, a temperature sensor-monitored heating coil maintains the ideal cutting temperature for ice cream. When the first scoop is finished, a rack and pinion mechanism lifts the ice cream, finishing the automated process with user-friendliness in mind.

III. WORKING PRINCIPLE

Temperature sensor, Arduino Uno, servo motor, heating coil, rack and pinion are all used in this project. The Arduino Uno controller receives temperature data from the thermocouple sensor, which measures the scooper's temperature. Heat cutoff switches and other safety features are triggered by the controller when the temperature rises above a preset level, potentially causing overheating and damage. Furthermore, a DC motor that is likewise managed by the Arduino Uno runs for a short while. The servo motor starts up in response to inputs from the controller. This project successfully automates the scooping process; the rack and pinion mechanism lifts until the desired level of ice cream is reached. Embedded C programming, developed using the Arduino UNO, controls the entire process, which is then uploaded to the Arduino Uno via the tiny type-B connector.

IV. UNITS

Nm - Torque, measured in **Newton-meters.**
N - Speed, measured in **Revolutions per minute (RPM).**
Power (P) - Watts (W)
mm - millimeter
Seconds - Time in seconds

A. Figures and Tables

The below graph shows the number of ice-cream scoop taken by manual vs automatic scooper.

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Table 1: Manual scoops vs Automatic scoops

S No	Time in (seconds)	Manual scoops	Automatic scoops
1.	5	0.5	1.0
2.	10	1.0	2.0
3.	15	1.5	3.0
4.	20	2.0	4.0
5.	25	2.5	5.0

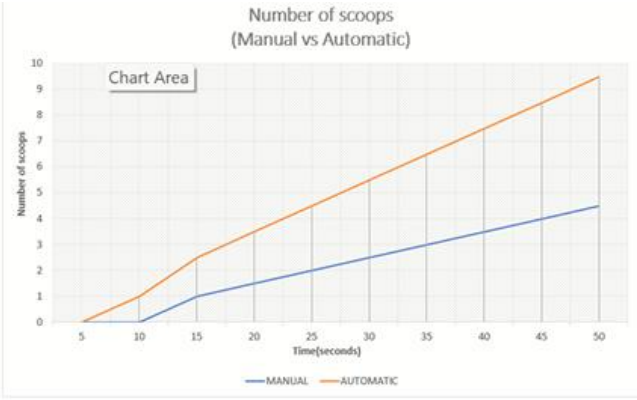

Figure 1. Number of scoops taken by manual vs automatic scooper

The torque-speed between constant torque and peak torque, showing that the more continuous torque at lower which increases in performance.

Table II: Speed vs Torque vs Performance

S.No	Speed (RPM)	Constan Torque (Nm)	Peak Torque (Nm)	Performance
1.	2000	0.25	1.25	1.0
2.	4000	0.25	1.25	1.25
3.	6000	0.25	1.0	0.5
4.	8000	0.25	0.5	0.1

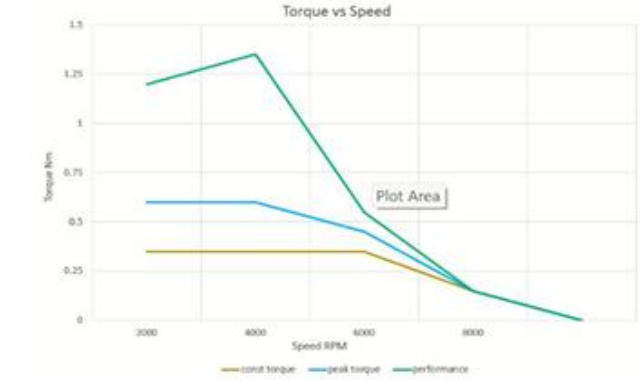

Figure 2. Torque vs Speed

B. References

Guo, Yijie et al [1] The design, development, and implementation of an automated scoop system for an ice cream business was the main goal of this project. The primary contributions include PLC and Arduino programming, LabVIEW, mechanical structure design for the assembly line, robotic arm, timing belt, and scoop, and stress analysis of the system's structures. This work resolved the issue of the need for technology to assist ice cream store staff in their laborious task and to increase the effectiveness of ice cream disposal. The scoop's innovative design addresses the problem of stress. The robotic arm that the control system was trained to utilize to scoop ice cream increased productivity. A stress and modal analysis was performed to guarantee system safety. The system underwent testing and validation, and the findings indicate that it operated as intended.

Gail Damerow et al [2]. I quickly stopped following recipes when I first bought my ice cream maker and started experimenting. Many of my early works were strange and disappointing. Discouraged by the absence of a thorough manual, I researched ice cream theory and sought advice from specialists. I learned that there are still a lot of unanswered questions in the subject of ice cream, so even professionals don't know everything. My love of learning about the complexities of ice cream made me realize its magic real cream enhances any taste and gives it a smooth texture. This quest captured the essence of creamy, classic sweetness and turned my creations into what's now acclaimed as "gourmet" ice cream.

Marshall, R.T et al [3] .Dairy desserts that are soft-frozen and beloved for their creamy texture are made fresh from pre packaged mixes and eaten right away before they solidify. Served as shakes, sundaes, and cones in fast-food restaurants and specialized stores, they have been a popular treat since the 1950s. Comparing this market to typical hard-frozen ice cream production, it requires less initial investment. Though vanilla still reigns supreme, tastes like chocolate, strawberry, and more recent coffee-based blends are becoming more and more well-liked. Mix-ins and flavored syrups are examples of customization options that increase customer choice. Desserts that are soft-frozen include ice cream, light ice cream, ice milk, frozen custard, and frozen yogurt. These options appeal to a variety of palates by providing rich but approachable desserts.

Hartel et al [4] Since the creation of the first snow cone, ice cream has advanced significantly. Over the past century, advancements in a number of fields have resulted in the creation of extremely advanced, automated production facilities that produce pint after pint of ice cream. The sector has been molded by notable advancements in areas like mechanical refrigeration, freezing and chilling technologies, cleaning and sanitation, packaging, and ingredient functioning. Product quality and shelf stability have also improved as a result of developments in our knowledge of the science of ice cream, particularly as it relates to comprehending the intricate structures that must be managed to produce a desired product. Despite the notable progress that has been accomplished, there are still a lot of prospects for scientific and technical growth.

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C. Abbreviations and Acronyms

FY25 - Financial Year 2024-25

LabVIEW - Laboratory Virtual Instrumental Engineering Workbench

PLC – Programmable Logic controller

MCU – microcontroller unit

DOF – Degree of Freedom

LED – Light Emitting Diode

D. Equations

The relationship between torque (T) and speed (N)can be approximated by a linear equation when considering ideal cases:

$T=T_{max}\ (1-N/N_{max})$

Where:

- T_{max} is the peak torque or maximum torque of the motor.
- $N_{max\ is}$ the maximum speed (RPM) at zero torque.
- Nis the speed at which you want to find the torque.

Calculating the Slope:

For two points (S1T1) and (S2, T2), the slope m is given by:

$m = T2-T1/S2-S1$

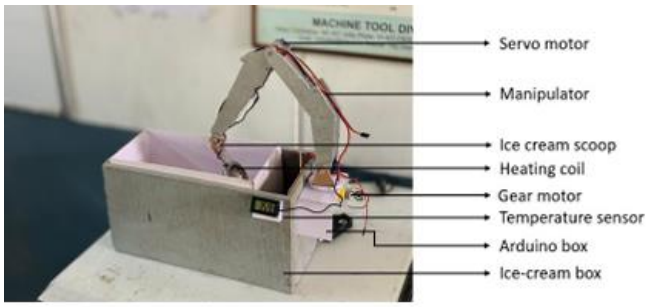
V. COMPONENTS USED

Table I: List of the Components

S No	Components	Specificatioms
1.	Arduino UNO	MCU: ATmega328
2.	Servo motor	Voltage:4.8volts, SG-90
3.	Thermocouple sensor	K- TYPE Voltage: 220volts up to 400 degree C
4.	Rack and Pinion	RackWeight: 20grams, Rack Length: 125mm, PinionShaftHole: 6mm, PinionTeeth: 25, Rack Teeth: 25
5.	Battery	9 V DC
6.	Heating coil	Nichrome wire

VI. FABRICATION PROCESS

Electrical interfacing involves both hardware and software parts. Hardware parts involves Dc gear motor, Arduino Uno and Servo motor these are controlled with embedded C programming, using Arduino ide to develop the program and dump into the Arduino UNO viva micro type-B connector. By using this hardware, we can able to connect the sequence process of the Arduino with motors.



VII. ELECTRICAL CIRCUIT

The most important electrical component or part is the microcontroller, i.e., Arduino UNO. This microcontroller is used to control the process of stamping and grouping in a smooth uninterrupted fashion. This Arduino board consists of input, ground, and various output pins through which it is connected to the power source and also to the output devices, here the linear actuator and motor. The program coded in Arduino IDE is dumped into this microcontroller, which then separates and distributes the signals to different pins in order to perform the logic given as input through Arduino cable from computer. The motor driver section is for converting the input voltage into required and desired voltage for the actuation of the linear actuator and motor. The buzzers and LED indicators are used as output devices as well, for indicating the flow of the process by the model. The jumper wires are used to connect various components with each other.

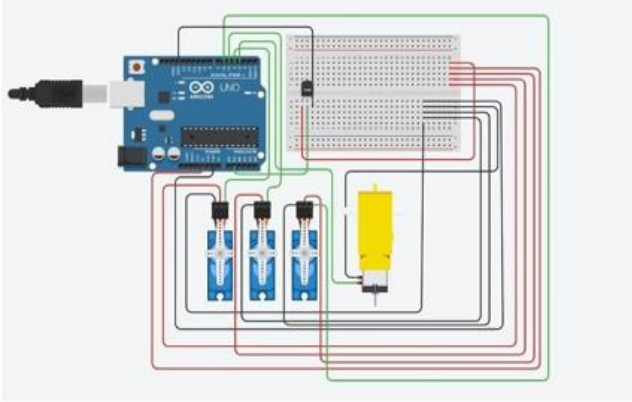


Figure 3. Electrical Circuit for ice-cream scooper

VIII. CONCLUSION

By upgrading of the ice-cream scoop and diameter and the length of the 2 DOF arm, the design and development can effectively meet the demands of the scooping process while ensuring precise positioning automatic ice cream scooper Scooping speed is doubled, Accuracy in serving size improves by **80%**. Efficiency in serving time improves by **50%** compared to manual scooper. Adding the point, its very useful to reduces the strain on wrists and hands, making it an move in different option. In conclusion, the automatic ice

cream scooper has proven that making the scooping process ease in way and offering a combination of efficiency and precision.

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