Department of MECHANICAL ENGINEERING
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AUTOMATIC ZEBRAFISH DISPENSER
"THE ZIPPER"

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INTRODUCTION

Medical researchers requested a device to increase the time efficiency of transferring zebrafish from a petri dish to individual wells. Currently researchers use 5mL disposable pipettes to individually "hunt" down zebrafish and transfer each one to their assigned well; which is time and labor intensive. This device was initially designed to fit the needs of Dr. Bonkowsky's lab where zebrafish are used to test the effect of drugs on embryo development.

OBJECTIVE

- Design a device for integration into an automated system capable of dispensing zebrafish individually from a large sample of fish.
- Reduce active time spent by users during the transfer process.
- Design a device that is capable of low dispensing error rate and high survival rate.

DESIGN SPECIFICATIONS

Design Metric	Desired Value
Survival Rate	> 80%
Error Rate	< 10%

PRODUCT DESIGN

The presented design uses a pair of syringe pumps for fluid control, as well as a photodiode sensing system to determine when dispensing should occur. One syringe pump controls fish flow, while the other syringe pump controls dispensing fluid flow.

Dispensing Process

- The syringe pump pushes fish into the sensing unit, which consists of a photocell and an LED, located on opposite sides of the fish channel.
- Once a fish casts a shadow on the photocell, the fish pump pushes the fish forward into the Y-junction.
- Once the fish is through the Y-junction, the dispensing fluid pump activates, pushing the fish out of the junction and into the desired location.

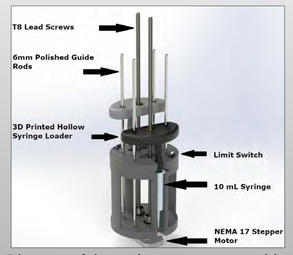


Diagram of the syringe pump assembly

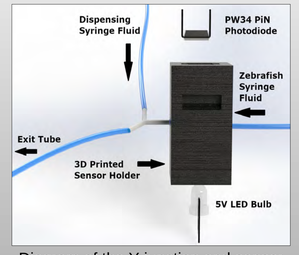


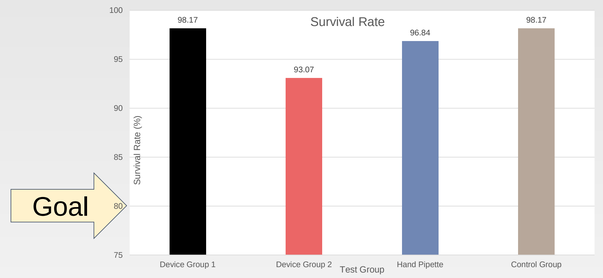
Diagram of the Y junction and sensor


Dish containing loose zebrafish


A 96 well plate with zebrafish

RESULTS

Test Group	No of Alive Fish Before Test	No of Alive Fish After Test	Survival Rate (%)
Device Group 1	203	200	98.17
Device Group 2	101	94	93.07
Hand Pipette	95	92	96.84
Control Group	164	161	98.17



Test Group	Actual Number of Fish in Dish	Number of Fish Detected by Sensor	Sensor Error Rate (%)
Device Group 1	203	227	11.8
Device Group 2	101	111	9.9

The results achieved from testing indicate that the device meets design specifications. The survival rate for the device is above 90%, and the error rate for Group 2 is lower than the desired 10% showing that the system's accuracy satisfies constraints. Group 1 has an error rate of slightly above 10%, but with further iterations this number can be lowered to meet the design metrics.

CONCLUSION

The designed device has been proven to operate fully automatically within desired specifications and may be integrated into an automated system that would free users from transferring zebrafish by hand. With further optimization and design, this device can be integrated into a CNC router moving stage to allow for the user to dispense fish into preprogrammed locations, improving the versatility of the device and allowing for truly automated zebrafish transfers.