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United States Department of Agriculture
Project Initiation

Project Data for Accession Number 1023136

Project Title

Automation for Lowering Crawfish Harvesting Costs

Project Details

Sponsoring Institution National Institute of Food and Agriculture	**Project Status** COMPLETE
Funding Source NIFA Non Formula	**Grant Year** 2020
Grant No. 2020-67022-31698	**Cumulative Award Amt.** $198,513.00
Proposal No. 2019-06470	**Multistate No.** (N/A)
Project Start Date Jul 01, 2020	**Project End Date** Jun 30, 2024
Program Code [A1521] Agricultural Engineering	

Project Director

Theegala, C.

Recipient Organization

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Performing Department

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Non Technical Summary

Crawfish aquaculture is receiving unprecedented attention both within and outside the United States, and has expanded to a multi-billion dollar global industry. Consumer demand, non-intensive growing conditions and sustainability attributes are all contributing to expansion. In 2018, Louisiana produced approximately 153 million pounds of aquacultured crawfish on 235,984 acres, up 6% from the previous year. Several states with established rice industries are also exploring crawfish cultivation. Crawfish are produced in flooded fields with baited traps that are harvested 40-90 times per year. Baiting and trapping (labor) typically account for over half of production expenses. For the US crawfish industry to compete globally and continue expanding, robotic harvesting will be critical for lowering costs and reducing dependence on labor. Robotic harvesting offers advantages for significant scale-up and expansion by uncoupling linkages to worker fatigue, high labor costs and worker shortages. The first phase of this seed grant research will focus on development of innovative yet economical traps that are conducive to robotic handling. The

second phase of the seed project will focus on development of trap sensing technology and robotic operation (pickup, emptying, re-baiting, and resetting traps). Conceptually, the proposed crawfish harvesting system is analogous to a garbage pick-up truck with a human driver and with a robotic arm for lifting, emptying, and resetting garbage bins. Upon successful testing and demonstration, AgCenter investigators plan to seek external funding from state and federal agencies to advance this effort to a fully autonomous robotic harvester.

Animal Health Component

Animal Health Component: 0%

Research Effort Categories

Basic	40%
Applied	30%
Developmental	30%

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
135	3799	2020	50%
402	7210	2020	50%

Knowledge Area

[135] Aquatic and Terrestrial Wildlife

[402] Engineering Systems and Equipment

Subject Of Investigation

[3799] Cultured aquatic animals, general/other

[7210] Remote sensing equipment and technology

Field Of Science

[2020] Engineering

Keywords

automated, crawfish, harvester, autonomous vehicle, labor cost, robotic arm

Goals / Objectives

The long-term goal of the proposed seed project is to lower production costs and improve the competitive position of the US crawfish industry. An intermediate-term objective of this project is to evaluate crawfish automation in a commercial setting with funding from larger grants (such as an AFRI Standard Grant). Specific objectives of the current seed project are:Design, build, and test several new crawfish traps that: 1) are sturdier, 2) have higher

trapping efficiency (and less escape) and 3) are more conducive to robotic handlingDesign and built a prototype robotic arm that can lift selected trap(s) (finalists from objective one) with live crawfish, harvest the trapped crawfish, re-bait the traps and reset them in the correct vertical position.

Project Methods

The proposed work is described below as project tasks.Task 1. New Crawfish Trap Design, Fabrication, and Testing: Several new crawfish traps will be designed and built in the Biological and Agricultural Engineering (BAE) Department at LSU. Emphasis will be placed on ease of trap pickup with a robotic arm, structural integrity to tolerate manipulation by the robotic arm, quick evacuation of crawfish, fail-proof re-baiting, and efficient re-deployment in a flooded pond without tilting or tripping. Gripping collars and lightweight stabilizing bars will be added to improve trap stability during the process. Special considerations will be given to minimizing weight and improving structural integrity of the traps. Trap designs will be developed with input from several former crawfish experts at LSU AgCenter and commercial crawfish farmers.Task 2. Field Testing of New Traps: New trap prototypes will be tested with live crawfish at the LSU Aquaculture Research Station. Camera recordings (including one underwater camera) will be employed to assist in visualizing the actual trapping process. Finally, the overall effectiveness of the new traps will be benchmarked against the most widely used commercial, welded wire mesh pyramid traps.Task 3. Robotic Arm Design and Fabrication: The robotic harvest system will be comprised of a three-axis arm. The arm will be guided to the trap by machine vision, optical sensors, or mechanical feelers. The robotic arm will be designed to accommodate a ± 3 ft variability in trap location. This is needed as it is not possible for a boat operator to keep the boat exactly at a specified distance from the traps when traversing along a straight path. Apart from the sensory and three-axis rotational components, the robotic arm will be fitted with a gripping claw, a counter balance to offset the weight of the trap and the arm, a vibrator for shaking out the crawfish gripping the cage wire, and a control center. Fabrication will be done in the BAE machine shop. Specific parts that are not commercially available at industrial supply or robotic supply stores will be fabricated in-house.Task 4. Testing of the Robotic Arm: Mounting of the arm in the center of a flat bottom crawfish harvesting boat and field-testing will not be attempted on this seed grant. The operation of the arm will be tested in the BAE machine shop. Upon contact with the trap, a grasping mechanism will close on the throat of the trap and simultaneously lift the trap from the water. After lifting, the arm will swing the trap over to a sorting table (with grading bars), turn it upside down, and then provide a shaking action to displace crawfish from the trap. After shaking, the trap will be turned upright and re-positioned below the automated bait station. After baiting (formulated baits), the trap with be positioned over the water and released upon command of the operator. Accuracy and consistency of sensing the location of the throat of the trap, harvesting, re-baiting and re-setting will be evaluated experimentally, under controlled conditions and with video recordings. The probability of tripping of the trap and any horizontal deviation (in pickup distance from the boat or mounting platform) introduced during the trap-resetting stage will also be experimentally assessed and quantified.Task 5. Overall Viability Assessment: First, improvements in trapping efficiency (and reduced escape rates) from the new trap design and overall suitability of new designs for robotic handling will be evaluated. The overall technical viability of the robotic harvester will be evaluated. Any shortcoming will be identified for future improvement.