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Opportunities and Strategic Use of Agribusiness Information Systems

Ferdinand Ndifor Che, Kenneth David Strang,
and Narasimha Rao Vajjhala

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Ferdinand Ndifor Che
W3-Research, USA & APPC Research, Australia

Kenneth David Strang
W3-Research, USA & APPC Research, Australia

Narasimha Rao Vajjhala
University of New York Tirana, Albania

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Chapter 13
Design of an Agribusiness Innovative and Autonomous Robot System for Chemical Weed Control for Staple Food Crops Production in Sub-Saharan Africa

Jibril Abdullahi Bala
https://orcid.org/0000-0003-4886-3924
Department of Mechatronics Engineering, Federal University of Technology, Minna, Nigeria

Olayemi Mikail Olaniyi
https://orcid.org/0000-0002-2294-5545
Department of Computer Engineering, Federal University of Technology, Minna, Nigeria

Taliha Abiodun Folorunso
Department of Mechatronics Engineering, Federal University of Technology, Minna, Nigeria

Emmanuel Daniya
https://orcid.org/0000-0001-5493-3672
Department of Crop Production, Federal University of Technology, Minna, Nigeria

ABSTRACT

Agriculture and agribusinesses suffer from many challenges, despite their significance to global economic growth. One of the challenges is the lack of appropriate technology to drive the industry to the next level of development. This technological gap contributes to reduced yield and profit without a reduction in manual labour, cost, and stress. Robotics have been explored to boost agricultural production and improve agribusiness productivity. Several weed control robots have been developed for research and field uses, but these systems are not suitable for weed control in large commercial farms or lack control schemes for navigation and weed control. This study presents the design of an autonomous robot system for chemical weed control. The system uses control theory, artificial intelligence, and image processing to navigate a farm environment, identify weeds, and apply herbicide where necessary. Upon implementation and adoption, this system would increase agricultural productivity with minimal human input, thereby leading to an increase in revenue and profit for agribusinesses.

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INTRODUCTION

The concept of Agribusiness is the sum of all operations involved in the production and distribution of farm produce, farm production operations, storage, processing, and distribution of farm commodities (Ikenwa, Sulaimon, & Kuye, 2017). It is a generic term for different businesses involved in the production and along the value chain of an agricultural commodity which includes but not limited to subsistence and mechanized farming, the supply of seeds, fertilizers, manure, chemicals, machinery, marketing, and financing of the agricultural industry (Munonye & Esiobu, 2017).

In recent times, there has been increased pressure on the agricultural industry and agribusinesses to operate and deliver more efficiently and effectively due to an increase in the world's population (Munonye & Esiobu, 2017). Agribusiness has the capacity and potential to provide increased employment, poverty reduction, higher income, and food security (Tersoo, 2013). Nevertheless, given the sector's ability to revolutionize the sub-Saharan African region's agricultural commodity production, agribusiness suffers from numerous constraints. The challenges associated with agribusinesses in Sub-Saharan Africa include poor policy articulation, inadequate working capital, lack of suitable technology, and inadequate agricultural infrastructure (Munonye & Esiobu, 2017). These challenges limit the revenue and profits generated from the industry.

Productivity in agriculture and agribusinesses can be increased by appropriate, accurate, and usable information and knowledge. Agricultural information interacts with agricultural productivity in a variety of ways, influencing it. It helps inform land, labor, livestock, capital, and management decisions. Consequently, the processing of agricultural information (through extension facilities, research, and education programs) is most mostly handled by agricultural organizations that build information systems to disseminate knowledge to farmers (Demiryurek, 2008). This knowledge enables the farmers to make informed decisions to take advantage of market incentives and handle constant improvements in their production processes. Information obtained from farms can be collected using systems that employ the concepts of Precision Agriculture, Artificial Intelligence, and Robotics. These devices rely on the use of sensors to obtain environmental data which can then be analyzed using a variety of software tools.

Globally, there has been an increase in the application of robotic systems to automate agriculture-based problems (Roldán et al., 2018). According to the United Kingdom Robotics and Autonomous Systems (UK-RAS) Network, robotics and autonomous systems will transform numerous global industries including the agricultural sector through the development of technologies aimed at maximizing profit and increasing yield (UK RAS Network, 2018). In addition, advancements in precision agriculture have resulted in the utilization of intelligent machines to minimize human involvement while increasing agricultural output. The development of robots and their application in agriculture has increased leading to the exploration of possibilities to adapt rational mobile robot solutions based on behavioral approaches (Pedersen, Fountas, & Blackmore, 2008).

A major problem faced by farmers is the prevalence of weeds. A weed is any unwanted crop that grows in an unwanted area. Weeds reduce not only yield but also the confidence of farmers by creating a poor return on investment. Weeds also result in higher production costs and lead to seedling contamination. Manual weed control with hand-held hoes and manual application of herbicides with knapsack sprayer is labor-intensive and exhausting. This fatigue-inducing weed control approach discourages a lot of people from moving into crop farming (Olaniyi, Daniya, Kolo, Bala, & Olanrewaju, 2020). In a quest to improve agricultural productivity, attempts have been made to introduce robotic systems for weed management. However, these systems have drawbacks such as inadequacy for vast outdoor fields,