Chapter 10
Smart Agriculture With Autonomous Unmanned Ground and Air Vehicles: Approaches to Calculating Optimal Number of Stops in Harvest Optimization and a Suggestion

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ABSTRACT

This study researches smart agriculture and its components, robotic systems and machine learning algorithms, development of agricultural robots, and their effects on the industry. In application, it is aimed to collect the harvest of autonomous unmanned aerial vehicles and UGVs in communication with each other by means of time minimization of the target. It wanted to be tested with different approaches for an optimal number of stops by using particle swarm optimization. Deterministic, binary mixed (0-1) integer modeling was used to determine the optimal picking time of the apples allocated to the stalls with the k-means method. With this modeling, it has been determined which unmanned aerial vehicle will be collected and how it is calculated whether the air vehicle has collected the apple or not using 0-1 binary modeling. The route of the unmanned UGV was made by using the nearest neighbor, nearest insertion, and 2-opt methods. This study has been extended and reviewed by the summary paper at International OECD Studies Conference March 2020, Ankara, Turkey.

DOI: 10.4018/978-1-7998-1722-2.ch010

Artificial Intelligence and IoT-Based Technologies for Sustainable Farming and Smart Agriculture

INTRODUCTION

Twenty-first century robotics and sensing technologies have the potential to solve long-standing problems in the agricultural field. It is possible to make crops more efficient and more sustainable by switching to an agricultural system using robotic systems. Many researchers in the world carry out robotic automation studies that will reduce the cost and increase the quality in greenhouses where fruit and vegetable production is made. Autonomous robotic pickers are tested, monitoring vegetable and fruit growth and harvesting crops. For livestock farmers, sensing technologies help manage and control the health of their animals. In order to improve soil quality, monitoring and maintenance works are carried out to eliminate harmful pests and diseases without resorting to the indiscriminate use of agricultural chemicals.

Although some of these technologies are already available, most of them are still at the research stage in start-up companies. Large-scale companies that produce agricultural equipment do not want to invest in autonomous agricultural technology yet. The reason for this is the fear that the economic model established by these companies in the current production and sales markets will change. Start-up companies working with digital agricultural technologies will also change the way we produce food forever if they manage to implement their projects in the agricultural sector. Our current food production will double, and this rate will increase until 2050, and will meet the food demand of 70% of the global population.

After the industrialization process that started with the industrial revolution, engineers and scientists have been creating solutions by designing great inventions and systems for the great problems that humanity has faced for centuries. Agriculture 5.0 will be the first major problem that scientists and engineers will face in the first half of the 21st century. The concept of Agriculture 5.0 states that farms use sensitive farming features and implement digital agriculture by implementing equipment including unmanned operations and autonomous decision support systems. Therefore, Agriculture 5.0 refers to the use of autonomous robots and some artificial intelligence systems Zambon (2019).

In traditional farming in the world, the workers in the seasonal working class go to agricultural work from different regions in the world to different countries in order to meet the global agricultural labor force every year. Due to the global epidemic of Covid-19, seasonal workers cannot leave, so many countries face the danger of deterioration in the field Brelie (2020). In addition, the rate of migration from villages to cities continues to increase every year. As a result of these, The World is moving away from the agricultural society every year and the population is growing rapidly in the cities. These problems show us that we will have great labor problems in the agricultural sector in the coming years ILO (2020). Autonomous robotic systems in agricultural production provide production by working 30 times more than an agricultural worker Hooijdonk (2020); Walch (2020). We need to face the fact that the world will face other outbreaks like COVID-19 in the future, give up the classic human-worker method and accelerate the transition to robotic-agricultural production.

According to a research conducted by Forbes Walch (2020), agricultural robots can harvest crops in the field in higher amounts and faster than human labor. Although robots are not as fast and efficient as humans in most sectors today, this is not the case for the agricultural sector. Agricultural robots rapidly fulfill repetitive routine tasks on the farm everyday thanks to the rapidly developing autonomous robotics