Chapter 2

Image Processing Techniques Aiding Smart Agriculture

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ABSTRACT

With the ever-increasing load of satiating the agricultural demands, the transition of the orthodox methods into smart ones is inevitable. The agriculture sector for long has served as a momentous source of livelihood for many globally. It is arguably a major topic for nations of the development spectrum, contributing towards their export earnings and aiding in their GDP assessment. Thus, it is quite conspicuous that nations would work towards its expansion. In congruence, the burgeoning population and its demands have posed a threat to the environment due to extensive exploitation of resources, which in turn is escalating towards the downfall of the quality and quantity of agricultural produces requiring a 70% increment in the produces by 2050 for sustainability. To combat such hurdles, developed techniques are being employed. Through a survey of existing literature, this chapter provides a comprehensive overview of various image processing means that could come in handy for ameliorating the present scenario and shows their implied extension in the smart farming world.

INTRODUCTION

“Time is money”, a beautiful quote by Benjamin Franklin, indeed lucidly highlights the importance of time. The advent and subsequent improvement of digital image processing techniques around the 1960s and 1970s allowed images to be effortlessly and effectively studied saving time, rendering a myriad of information contained within those pixels and recognizing patterns for specific purposes. However, back in time, the computing systems had constrained performance and were expensive, posing a hindrance to its proliferative usage. In parallel, machine learning was emerging as a breakthrough in the world of sci-

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ence and technology, subsequently leading to what we coin as ‘Deep Learning’ today. These techniques envisioned the plausibility of machines emulating the human brain and possessing the ability to decipher and learn on its own, and therefore had potential to automate the arduous manual procedures carried out by humans, in every extant sphere. By the 2000s, fast processors and systems were widely available for which they started gaining immense popularity. Consequently, their application domain widened and researchers over the world started making use of these methodologies in order to enhance the present scenario in various sectors, including the agricultural sector, thus opening a doorway for reduction of the colossal amount of time invested on traditional agricultural practices.

Several challenges, such as deteriorating food quality, unsuitable climatic alterations, dearth of food, etc. have prevailed through the years and are escalating. As a result of recent advancements in digital technologies, image processing and machine/deep learning techniques could come handy in several ways within agricultural practices leading to the notion of “smart agriculture” or “smart farming”, where digital and biotechnology, such as remote sensing, Internet of Things (IoT) and cloud computing, in conjunction with signal processing and decision-driven automating techniques alleviate the present agricultural ecosystem (Kamilaris et al., 2017). It engulfs within its coverage soil analysis, food quality assessment, weeds recognition and many more detailed in this chapter. The traditional processes are quite arduous and time consuming, and a viable promising solution to this plight can be envisaged, buttressed by image processing and deep learning models.

Hurdles Faced and Discrepancies in Extant Agricultural Systems

To summarize, the traditional agricultural system is flawed in many ways, as is manifested through its incapability in addressing hurdles faced by agricultural practitioners:

- **Weed Management**: The extant systems require the ranchers to examine the crops fanned out over large fields intently and eradicate them by perspicacious examination. This requires a lot of time and effort, besides leaving a large fissure for human errors.
- **Cost and Time Management**: Since the farmers generally glean specific accurate information, without much reliable sources, and use manual tools, a lot of wastage occurs. Consequently, there is a good chunk of hard-earned money and time squandered.
- **Disease Prevention**: Periodic inspection and insightful knowledge is required for disease detection. This drains in a lot of expertise and time. Moreover, appropriate and best-suited recovery techniques are required for recuperation, which is usually beyond the knowledgeable domain of farmers.
- **Pest Control**: Scrutinizing the fields is a bulky task for the farmers since there is a large amount of labor and time required for the purpose. There is also a likelihood of a certain pest control medication adversely affecting an adjacent crop, thereby causing tarnish.
- **Weather and Soil Suitability**: Soil and atmospheric conditions play a crucial role in the growth of crops. Some crops require a rainy weather whereas others require a rather hot and humid weather, some require moist soil some dry. Till recently, there has been no such scheme to relate these and such overlooking has led to lesser yield.