A Study on Deep Learning in Agriculture

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ABSTRACT

We have seen in recent years an amazing improvement in applications using Deep learning. It started with speech recognition then moved on to computer vision, object recognition and natural language processing. Deep learning constitutes a recent, modern technique for image processing and data analysis, with promising results and large potential. Deep learning are machine learning algorithms based on learning multiple level of abstraction. As deep learning has been successfully applied in various domains, it has recently entered also the domain of agriculture. In this paper, we explored the platforms that employ deep learning techniques, applied to various agricultural and food production challenges. We examine the particular agricultural problems under study, the specific models and frameworks employed the sources, nature and pre-processing of data used, and the overall performance achieved according to the metrics used at each work under study. Moreover, we study comparisons of deep learning with other existing popular techniques, in respect to differences in classification or regression performance. Our research findings indicate that deep learning provides high accuracy, outperforming existing commonly used image processing techniques.

Keywords: Deep Learning, Classification, Regression

I. INTRODUCTION

It is expected that global population will reached 9 billion in 2050.it means we require more agricultural production in order to meet food demands. Otherwise we will be suffering from food security problems. So we have to increase our per unit area production. In agriculture we emphasis on yield. For increasing yield, our farm enterprises require new and innovative technologies to face and overcome these difficult challenges. So we are using different methodologies, technologies, and different processes for higher yield per unit area. In methodological approaches we can use different simulation models, but nowadays deep neural network or deep learning is also used in modern countries. Deep learning is a discipline of Computer Science that deals with giving ability to the machines that it seems to behave like, that it has human intelligence. There is a lot of scope of deep learning in many fields of life like in Agriculture that it can monitors crop conditions, like water scarcity conditions, plant population in field and soil moisture content etc. Deep learning is working in almost all disciplines of agriculture. In Irrigation it can control irrigation water in the field we can optimize the use of water because it have automatic irrigation systems in it that take weather conditions and predicts amount of water to be applied. Non chemical weed control is used in discriminating between weeds and crop seedling. It is an important step towards control of weeds by nonchemical way. Drone technology is another adoption of Artificial intelligence. Drones can be used to provide detailed mapping of crops in the fields. They are also capable of delivering customized fertilizers pesticides, insecticides based upon the requirement of each crops.

Artificial intelligence and deep learning algorithms has been found useful in almost every field of work

and study. It being deployed in every field makes it the next big thing and breakthrough for a smart future. In India, especially in Punjab increasing agriculture output to meet ever increasing population's demand is one of the major issues being faced today. Agricultural experts would tell that factors like climate, soil, rain along with other factors affect the output of a crop. Farmers feel immense pressure in such situations and lack of knowledge to counter the problems faced and modern techniques of farming only add further to the problem. There have been various sorts of efforts to implement deep learning and check the innumerable effect it has on different aspects like production time, assistance, output etc. We have seen field of medical science specifically benefitting from the implementation of deep neural networks. Researchers are constantly working of technologies like machine learning, deep neural network to aid artificial intelligence as a product for human use.

II. RELATED WORK

If we look specifically towards the field of farming, quite a lot of research is being conducted. Research on topics like hydration characteristics of Wheat, applying machine learning to agricultural data show that farming activities can greatly benefit from deep learning. Every research being done aims to improve the control of input variables such as fertilizer, seed, chemicals or water with respect to the desired outcomes of increased profitability, reduced environmental risk or better product quality. Research on some specific important crops like wheat are being carried out to because crops like wheat, rice need high output to meet the mass demand and any case of crop failure means huge loss. So deep learning can reduce chances of crop failure due to improper farming activities. This all data is learned and used by deep learning. Hence, a lot of research is being conducted for the same.

III. DEEP AGRICULTURE FRAMEWORK

In this paper we explore applications of deep learning to provide business leaders with an understanding of current and emerging trends, and present representative examples of popular applications. The most popular applications of Deep Learning in Indian agriculture appear to fall into three major categories:

i. Crop and Soil Monitoring – Companies are leveraging sensors and various IoT-based technologies to monitor crop and soil health.
ii. Predictive Agricultural Analytics – Various AI and machine learning tools are being used to predict the optimal time to sow seeds, get alerts on risks from pest attacks, and more.
iii. Supply Chain Efficiencies– Companies are using real-time data analytics on data-streams coming from multiple sources to build an efficient and smart supply chain.

Here we explore various Deep and machine learning frameworks that helps our farmers to strengthen their crop production.

A. Intello Labs – Using Deep Learning for Image Analysis

Bengaluru-based Intello Labs was started by IIT-Bombay alumnus Milan Sharma in May 2016. The company claims to provide advanced image recognition technology that can recognize objects, faces, flora and fauna and tag them in any image. The company claim to use deep learning algorithms on which a new generation of intelligent applications are being built for applications including agriculture, e-commerce, advertising, manufacturing, and curation. Small farmers around the world follow traditional farming practices due to lack of access to scientific understanding of crop lifecycle, pests, quality metrics and the latest micro-fertilizers. Intello Labs Image based solutions provide insights on the crops' health during the growing season. Intello Labs claims to provide Agricultural Product Grading: Automated quality analysis of images of food products is an

accurate and reliable method for grading fresh products (fruits, grains, vegetables, cotton etc.) characterized by color, size and shape. Their solution reads the image that a farmer has taken on his phone and determines the product quality in real time, without any manual intervention. Alerts on Crop Infestation: Farmers can click an image of their crop and use their solution to understand the pests, diseases, and foreign plants (weeds) growing in their farms. The solution uses deep learning and image processing models to identify any crop diseases or pest infestation in the crops. Along with the parameters, it gives recommendations on how that disease can be cured and prevented from increasing further.

B. Microsoft India – AI-Based Sowing App

Determining the right time to sow crops is often one of the biggest challenges for Indian farmers where drought and excess rainfall can be equally serious challenges. Microsoft in collaboration with ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), developed an AI Sowing App that uses machine learning and business intelligence from the Microsoft Cortana Intelligence Suite. The app sends sowing advisories to participating farmers on the optimal date to sow. The best part – the farmers don't need to install any sensors in their fields or incur any capital expenditure. All they need is a feature phone capable of receiving text messages.

Figure 1. A Photo of A Text Message From The Microsoft India AI Sowing

To calculate the crop-sowing period, historic climate data (spanning over 30 years from 1986 to 2015) for the specific area in Andhra Pradesh was analysed using AI. To determine the optimal sowing period, the Moisture Adequacy Index (MAI) was calculated.

MAI is the standardized measure used for assessing the degree of adequacy of rainfall and soil moisture to meet the potential water requirement of crops. Microsoft has also partnered with United Phosphorous (UPL), India's largest producer of agrochemicals, to create the Pest Risk Prediction App that again leverages AI and deep learning to indicate in advance the risk of pest attack. Today, these farmers across the Indian states of Andhra Pradesh and Karnataka wait to get a text message before sowing the seeds. As per the report cited above, in a few dozen villages in Telangana, Maharashtra, and Madhya Pradesh, farmers receive automated voice calls alerting them whether their crops are at risk of a pest attack based on weather conditions and stage of the crop. No specific numbers on the results were reported.

C. Gramophone (Agstack Technologies) – Image Recognition for Soil Science

Based in the Indian state of Madhya Pradesh, Gramophone claims to leverage the power of image recognition and soil science to help farmers with timely information, technology, and right kind of inputs to achieve better yields. This technology platform uses deep learning to predict pest and disease, forecast commodity prices for better price realizations and recommends products to farmers. Gramophone use temperature, humidity and pathology/entomology data to give accurate advisory to the farmers. Gramophone primary focus is to digitize agriculture science and convert it into actionable information for the farmers to provide personalized farm management solution, which would guide farmers across the cropping cycle.

IV. CONCLUSION

Given the huge potential of agriculture in India, it's imperative that deep and intelligent technology is used to the maximum so that both farmers and consumers can make the most of it. With recent advancements in technology coupled with conducive

government policies, we have seen many agtech startups emerge in the country which is a great starting point for the penetration of advanced technologies like AI in agriculture. AI and deep learning comes as a great boon to the agricultural sector which is heavily dependent on climatic conditions which are often unpredictable. Throughout the paper, we have seen instances of how companies are using sensors for crop and soil monitoring, as well as AI and deep learning tools for predictive analytics. More and more use cases of deep learning in agriculture are likely to show up in the near future because of the immense value it can add.

V. REFERENCES

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