Hydroponic Farming using Leafy Green Machines for Agriculture by Applying Deep Learning Methods

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Abstract - Deep learning constitutes a recent, modern technique for new variants in agriculture with quality yield, minimal resources and large potential. As deep learning has been successfully applied in various domains, it has recently entered also the domain of agriculture. In this paper, Leafy green machines are employed for agriculture using deep learning techniques for food production challenges. By examine the production and agricultural problems under study the novel technology of leafy green machines can be implemented for overall performance. Hydroponic system, multi-planned air flow, moisture, amount of nutrients thresholds of carbon di-oxide and nitrogen can be controlled and operated using deep learning techniques. IoT sensors and use of UAVs assist in controlling the other aspects of production. The study evaluates the application of deep learning methods provides high quality yields of production.

Keywords - Deep Learning, Agriculture, Leafy Green Machines, Virtual Farming, Hydroponic Farming, Controlled Environmental Agriculture

I. INTRODUCTION

Size of the earth stays to be a constant but population spawns, increasing variably. From the intelligent systems, it is clear that the amount of crop yield prevailing in today's world will become scarce by 2050. The shortage of crop production can be due to various reasons such as water scarcity, weather conditions, urbanization and lack of humans working in agriculture sector [1,2].

Human has been dealing the scarcity of food since the past, but some solutions such as food preservation, invention of fertilization and mechanized farming to speed up the process to handle the scarcity. However, due to the exponential growth in the population globally, development of transport sector, urbanization and decrease of farming land are likely to decrease the quantity of crop production to diminish drastically.

Pollution, soil-erosion and environment circumstances are added factors by degrading the quality of land. Now, it is high time to take some necessary action to protect the resources, which are very much essential for growing crops.

To address the prevailing problems advanced technologies are required to automate the things and take necessary actions timely. AI and DL are some of the technologies, which can be adapted to address these problems [3]. Many researchers and scientists are working towards these problems widespread across the agriculture sector. Prediction, weather forecasting, crop outcome, monitoring water levels, detecting crop diseases, type of soil and removal of weeds are some of the major areas of research through deep learning methods [7,8].

Artificial Intelligence, Machine Learning and Deep Learning are novel advanced technological computational intensive methods [9]. These techniques can be collaborated with agriculture sector for a unique research to improve the speed, type, new variety and protection should be employed.

Super computational power of deep learning techniques analyse the stream line methodology to understand the compatibility of molecules by using AtomNet framework. This technique even identifies controlling mechanism of insects and pests by predicting the peculiar patterns of molecules which are given for crops while breeding [10, 11].

Discovering innovative practices for high yields, diversified plant breeding and crop protection sophisticated artificial intelligence and machine learning methods are applied [12, 13]. With the development of technology small farmers problems can be waived by implementing these unique approaches for agriculture.

Environmental changes, ecological disorders, soil quality and temperature variants can also be taken care by using the modern techniques [14]. These imbalances should be overcome for better harvests, protect their crops and deliver more to society in the face of mounting environmental challenges. Some solutions are given by leafy green machines by applying the hydroponic farming techniques with artificial climatic conditions using artificial intelligence and machine learning. The main aim of this production is to support sustainable environment friendly production of crops. Leafy green machines produce crops such as green beans, variety lettuce, basil, mustard, mint and other tiny leafy veggies. Such a variety of taste, color and texture can also be decided for all veggies under production.

II. BACKGROUND OF A CASE STUDY

The case study considered in this paper is on leafy green machines which produce crops using hydroponic farming. This type of cultivation started in a urban campus where students are trained to grow veggies in the containers which are monitored using computers.

Student farmers are trained in consistent monitoring of crops and maintain certain environmental requirements such as climate, irrigation and ultraviolet sunrays [15].

Crops like green beans, spinach, peppers, tomatoes, lettuces and herbs are a small group which is produced using leafy green machines. Drip irrigation by re-circulating mixture of ingredients such as nutrients and water is given for the roots rather than for the soil. Some insights are drawn from various farm hackers community is discussed as below:

- Plant physiology to computer science can diminish the complexities and controversies of sustainability by Catherine Arnold.
- Graeme Marcoux applied remote sensing mechanism to operate the crop growth in the freight farms for the crop irrigation.
- Marcoux's vertical farms use conventional farming techniques indoors with no pesticides and fertilizers.
- Will Borden observed that indoor farms are energy hoggers. As this require energy costs, transport, refrigeration, farm tools and water supplies. He also pointed the energy generated by LED will shrink the carbon footprint in vertical farms.
- Crowdsourcing crops for potential network farmers using climate recipe and food systems are suggested by Caleb Harper.
- Edible plants in vertical columns with neon red energy generators and ceiling spigots for cascading water is one of the growing techniques by Shawn Cooney.

III. METHODOLOGY OF LEAFY GREEN MACHINES

Increasing food needs mitigating environmental effects of conventional farming raises the farmer entrepreneurs. Innovative farming practices growing fresh food in massive quantities is a challenge which is addressed by deep learning methodologies using Leafy green machines.

Sustainable farming is implemented to reduce environmental impacts of monocropping and eradicating dependable pesticides. Controlled Environmental agriculture has a greater impact on ecological footprint and market research for ability scaling in crop production.

- Spectrum of red and blue neon lights is used efficiently on crops for photosynthesis process.
- Mixture of nutrients and water solution is supplied in closed loops using hydroponic delivery system.
- Sensors are installed for monitoring the airflow, temperate and humid percentages in the environment.
- Controlling the pests and blights by regular examining the supervising using UAVs in Figure 1.
- Maintaining the winter weather for quality crop.

Figure 1: Leafy Green Machine with neon lights

A. Controlled Environment Agriculture

Freight farms introduced innovative technique of farming is Leafy Green Machine which facilitates "Controlled Environment Agriculture" (CEA). The actual process of neon lights for sunrays is generated, artificial climatic conditions, and auto-sensing water equipped in a mobile container of a small footprint. All kinds of produced crops can be cultivated throughout the year with maximum productivity. Season, climate and other ecological imbalances does not affect the crop yield.

B. Vertical Hydroponic Farming

Issues such as soil erosion, pesticides and fertilizer usage can be eradicated by adapting hydroponic cultivation which is a soil less growing of crops. The process involves continuous stream of water maintaining the humidity in roots using the re-circulated mixture of nutrients and water is supplied to the plants. In spite of extreme weather such as ice or snow or rainy or sunny the plants can sustain well with this Hydroponic environment. One important challenge is the continuous stream of water is to be maintained for appropriate moisture for the roots, otherwise hard LED lights harm the crop.

C. Leafy greens year around

The Leafy Green Machine enables us to grow dozens of varieties of lettuce in Figure 2, as well as other herbs and leafy greens including arugula, basil, chard, mustard greens, kale, mint, and others. Such a variety of taste, color and texture, all freshly harvested year round at our local farm. Even better, these greens are delivered very quickly after harvest with the root ball still intact for a very long shelf life.

Figure 2: Green lettuce from Leafy Green Machines

D. Linear Growing Feet

The main variable that distinguishes the difference between annual linear growing capacity of the LGM and conventional farming is the number of times crops can be harvested per year. The focus is on one crop for this exercise, lettuce, for consistency and data on this crop. Regardless of what our freight farmers are growing, the entire linear footage in the farm will be turned over

(harvested) a minimum of 8 times per year and a maximum of 12 times per year.

IV. DEEP LEARNING FOR LEAFY GREEN MACHINES

Agriculture plays a vital role in Indian economy, as it is the main occupation for many states in India. Protecting and providing the necessary equipments and tools is the minimum need to accomplish. In this section, some issues to advance the farming in India using deep learning techniques and application of Leafy green Machines are addressed.

Deep learning techniques in table 1 are recommended for a comprehensive and systematic analysis on hydroponic products into its value chain. Sustainability Oriented Innovation (SOI) framework to be the evaluation framework, as it very comprehensively covers all 4 key dimensions and then various aspects using several methods of deep learning for increasing quality production [17].

Dimension	Aspects	Deep Learning Method
Alignment	Aligning the hydroponic crops measuring capacities	Rate Decay Method
Suitability	Analysing the customer desirability and technical feasibility	Max Pooling
Scalability	Potential for diffusion of Hydroponic farming	Batch Normalization
Sustainability	Systemic impact of Hydroponic initiative on various subsystem	Recurrent Neural Networks

Table 1: Evaluation framework for agriculture using Deep Learning methods [16].

A. Recompense of DL for Sustainable on Agriculture

Economy, environment and social are the three subsystems for maintaining infrastructure in the row arrangement of field farms, maintaining non-renewable resources and customer satisfaction respectively.

Consumption, socially acceptable needs, user behavior in the purchase usage and end of life are some impacts of need fulfillment and system.

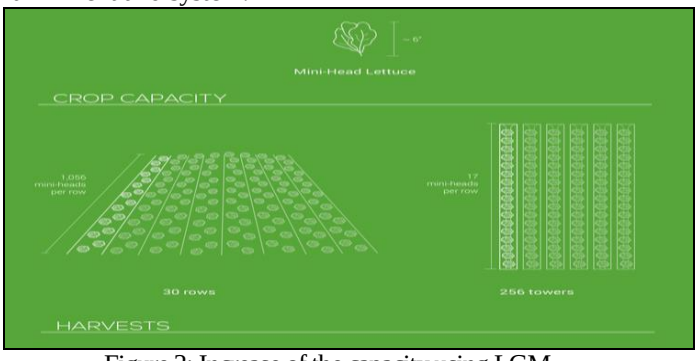

Figure 3: Increase of the capacity using LGM

These techniques of deep learning methods can be employed for improving the yield and quality of the crop in a very less time explained in figure 3. This machines use compact size for high yield production which are environmental friendly with no pesticides and fertilizers.

V. CONCLUSION

Agriculture is a field that has been lacking the mass adoption of technology and its advancements. Indian farmers need to be up to the mark with the international techniques. Deep learning is a naïve approach to understand the peculiarity, development and faults by image processing techniques. It has already established its prowess over conventional algorithms of computer science and statistics. Deep learning algorithms have enhanced the accuracy of artificial intelligence machines including sensor based systems used in precision farming. This paper has reviewed the various applications of Deep learning by application for various dimensions of vertical farming of Leafy green machines in the farming sector. It also provides an insight into the troubles faced by farmers and how they can be resolved using these techniques.

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