MACHINE LEARNING TECHNIQUES FOR PRECISION AGRICULTURE

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Bachelor of Technology
in
Computer Science & Engineering

By

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BONAFIDE CERTIFICATE

It is certified that the work contained in the seminar report titled ”MACHINE LEARNING TECHNIQUES FOR PRECISION AGRICULTURE” by ”LOGESHWARAN K S (20UECS0530), KAYAPATI SRAVANTH (20UECS0477) and BHUPATHI NAGASAI (20UECS0134) ” has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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ABSTRACT

Agriculture plays a vital role in the economic growth of any country. With the increase of population, frequent changes in climatic conditions and limited resources, it becomes a challenging task to full the food requirement of the present population. Precision agriculture also known as smart farming have emerged as an innovative tool to address current challenges in agricultural sustainability. The mechanism that drives this cutting edge technology is Machine Learning (ML). It gives the machine ability to learn without being explicitly programmed. ML together with IoT (Internet of Things) enabled farm machinery are key components of the next agriculture revolution. A systematic review of ML applications in the field of agriculture. The areas that are focused are prediction of soil parameters such as organic carbon and moisture content, crop yield prediction, disease and weed detection in crops and species detection. ML with computer vision are reviewed for the classification of a different set of crop images in order to monitor the crop quality and yield assessment. This approach can be integrated for enhanced livestock production by predicting fertility patterns, diagnosing eating disorders, cattle behavior based on ML models using data collected by collar sensors, etc.

Keywords: Precision Agriculture, Machine Learning, Internet of Things

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

PA	Precision Agriculture
ML	Machine Learning
AI	Artificial Intelligence
IoT	Internet of Things
WSN	Wireless Sensor Network
DP	Deep Learning
NPL	Natural Language Processing
CNN	Convolutional Neural Network
SVM	Support vector machine
RF	Radio Frequency
SI	Swarm Intelligence
ANN	Artificial Neural Network
KNN	K Nearest Neighbour
SSCM	Satellite Farming or Site Specific Crop Management

TABLE OF CONTENTS

Chapter 1

INTRODUCTION

1.1 Introduction

The population of the world will increase to 9.1 billion approximately thirty-four percent as of today by the end of 2050. Food requirement will increase by 70 percent and due to rapid urbanization; land availability for agriculture will decrease drastically in the coming years. India will be the most populated country by 2050 and presently it is already lagging the domestic food production. The main reason for reduced food production is the lack of planning, unpredictable weather conditions, improper harvesting and irrigation techniques and livestock mismanagement. In the last few years, nature has experienced a drastic change in weather conditions due to global warming. The average temperature of the earth has been increased due to which there is uncertainty in climatic conditions. Frequent droughts, heavy rainfall are the biggest challenge for poor farmers. According to the government of India annual economic survey, adverse climatic conditions, reduce the farmer's income by 20-25 percent.

Precision agriculture is one of the solutions to ensure food security for the entire world. Precision agriculture also abbreviated as digital agriculture is a technology enabled data-driven sustainable farm management system. It is basically the adoption of modern information

technologies, software tools, and smart embedded devices for decision support in agriculture Mechanized agriculture and the green revolution are the two key components of the first and second agriculture revolution. Precision farming is an important part of the third agriculture revolution.

1.2 Aim of the Seminar

The main aim of the seminar is to study about machine learning technology for precision agriculture. The mechanism that drives this cutting edge is ML. It gives the machine ability to learn, without being explicitly programmed.

1.3 Scope of the Seminar

The scope of the seminar is study about how ML techniques used in agriculture and how to implement ML technology in agriculture for farming as a successful model.

Chapter 2

LITERATURE REVIEW

H. Jawad, R. Nordin, S. Gharghan, A. Jawad, and M. Ismail, 2017, "Energy efficient wireless sensor networks for precision agriculture: A review", Sensors.

Focus entirely on WSN and IoT application in precision agriculture, which has great success in agriculture field.

R. Sharma, S. S. Kamble, A. Gunasekaran, V. Kumar, and A. Kumar, 2020, "A systematic literature on machine learning applications for sustainable agriculture supply chain performance'', Comput. Oper. Res.

It only includes ML as the technique in agriculture .which gives great result compared to Wireless Sensor Network without any human interference.

K. Jha, A. Doshi, P. Patel, and M. Shah, 2019, "A comprehensive review on automation in agriculture using artificial intelligence," Artif. In-tell. Agricult.

The Focus of the paper was about ML and IoT, excluding Wireless Sensor Network in Precision Agriculture for the best livestock man-

agement, yield prediction and diseases free crops.

K. G. Liakos, P. Busato, D. Moshou, S. Pearson, and D. Bochtis, 2020, "Machine learning in agriculture: A review," Sensors,

This focus on AI and ML in precision agriculture without any future guidance and trends. It is an overview and analysis of ML in agriculture. It explains the applications of WSN/IoT in precision agriculture along with challenges.

A. Chlingaryan, S. Sukkarieh, and B. Whelan, 2019, "Machine learning approaches for crop yield prediction and nitrogen status estimation in precision agriculture: A review," Comput. Electron.Agricult.,

This is mainly about sub fields of precision agriculture : crop yield, nitrogen estimation, crop diseases and weed detection, livestock management and intelligent harvesting.

Chapter 3

SEMINAR DESCRIPTION

3.1 Existing System

Over the year, there are lots of agricultural techniques followed in country and by many people. At the earliest the people used to monitor all the things about farming like soil fertility, percentage of yield, weather condition and so on. A existing method which we going to see about is precision agriculture, mainly Wireless Sensor Network (WSN).

3.1.1 Wireless Sensor Network

In recent times, WSNs are widely applied in various agricultural applications. Wireless Sensor Networks (WSN) are widely used in agriculture monitoring to improve the quality and productivity of farming. In this application, sensors gather different types of data (i.e., humidity, carbon dioxide level, and temperature) in real-time scenarios. Sensor Network (SNet) is a type of widely pervasive distributed system consisting of multiple sensor nodes deployed in a field that have the ability to mutually communicate via wireless networks. The task of this distributed system is to gather data by sensors and identify information

best describing the monitored phenomenon.

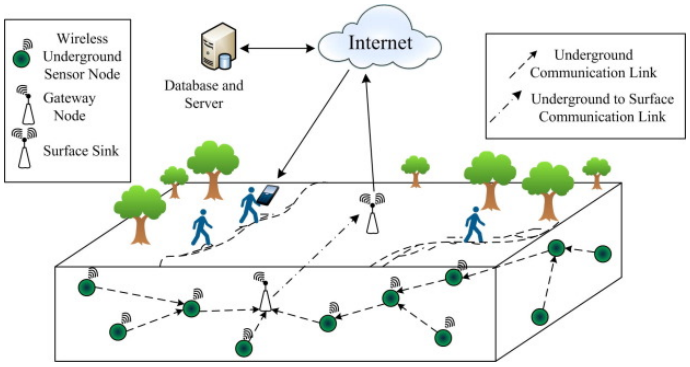

Figure 3.1: WSN Agriculture

WSN is a wireless network consisting of spatially distributed unassisted devices, called sensors, for monitoring the physical or environmental conditions and parameters. WSNs have become increasingly used in agriculture. They may be applied in the following areas: environmental status monitoring, precise agriculture, machinery and processes control, automatization of monitored areas, and monitoring systems.

Advantages

It is wireless in nature as well as it is installed once and it could be accessed through centralized monitoring system

Disadvantages

It is prone to hacking by hackers, It cannot be used for high speed communication and It works on the single based algorithm

3.2 Proposed System

As all those disadvantages as a concern, we can use ML in precision agriculture for the better improvement in algorithm and different working techniques. we can store those data in cloud for best solution using past occurred events. Using optimised algorithm for the less power consumption

3.3 Feasibility Study

Precision Agriculture is widely used technique by worldwide farmers. Technically Sensors, drones, robots should be maintained else it will be unnecessary cost and stop of work. It might be hard to make the setup and connectivity among them and cloud. Economically, The initial cost of the setup is high, it will return the with a profit in a year. This is legal but the data should be kept private, sometime it may lead to unexpected legal issue. Operationally, It will make immerse change in field of agriculture, there is need of person to taken care of and it can produce food without any wastage eventually it will increases the country wealth.

Chapter 4

METHODOLOGIES

4.1 METHODOLOGY 1

4.1.1 Precision Agriculture

The world is at the edge of the third modern farming revolution and Precision farming is an important part of it.Precision Agriculture (PA), Satellite Farming or Site Specific Crop Management (SSCM) describe the term as 'a technology-enabled approach to farming management that observes, measures, and analyzes the needs of individual fields and crops'.Predictive farming is analogous to taking a pill to target an ailment. The solutions are highly tailored from the type of crop suitable for a plot to the use of pesticides in targeted regions only. Adopting to Precision farming reduces the production cost and wastage, as tailored needs of each plot is catered to. Precision farming is practised by adopting analytical software and use of technical equipment. Rigorous data collection is done on soil testing, plot measurement, weather pattern analysis and crop analysis through sensor equipped devices placed along the fields. The data is calibrated to devise conclusions and based upon those results a very detailed and precise set of practices can be adopted.

4.1.2 Artificial Intelligence

AI technology provides computational intelligence to machines so that they can learn, understand and react according to the situation. ML, DL, Natural Language Processing (NLP), swarm intelligence (SI), expert systems, fuzzy logic, and computer vision are the subfields of AI as shown in figure 4.1.

Figure 4.1: Artificial Intelligence Techniques

This field finds endless applications across different sectors of human life. Intelligent AI programs are widely explored in health-care, agriculture, finance, robotics, e-commerce and the automation industry.The smart sensors can be utilized to gather data about farming.the agriculture industry is widely adopting smart technologies like IoT and AI to efficiently cultivate organic products in limited land areas as well as to overcome the traditional challenges of farmers. IoT based smart farming system is built for monitoring soil nutrients and soil moisture using sensors. ML algorithms are explored for determining the optimum amount of fertilizers required for soils before the sowing

of crops. Drones are revolutionizing the agriculture industry. These drones are cameras enabled and are used for different applications such as field and crop monitoring, spraying of pesticides, and drip irrigation. The images captured by the drone over the entire life cycle of crops can be examined using DL and computer vision algorithms for disease and weed identification. Thereafter, these drones are used for spraying pesticides over the weeds and infected crops.

4.1.3 Machine Learning

ML is the subfields of computer science that gives computers the ability to learn without being explicitly programmed. A machine or intelligent computer program learns and extract Knowledge from the data, builds a framework for making Predictions or intelligent decisions. As it collect all the data from the sensor as an input and data model those input and give optimal solution. ML have specific algorithm for all problem faced by farmers.

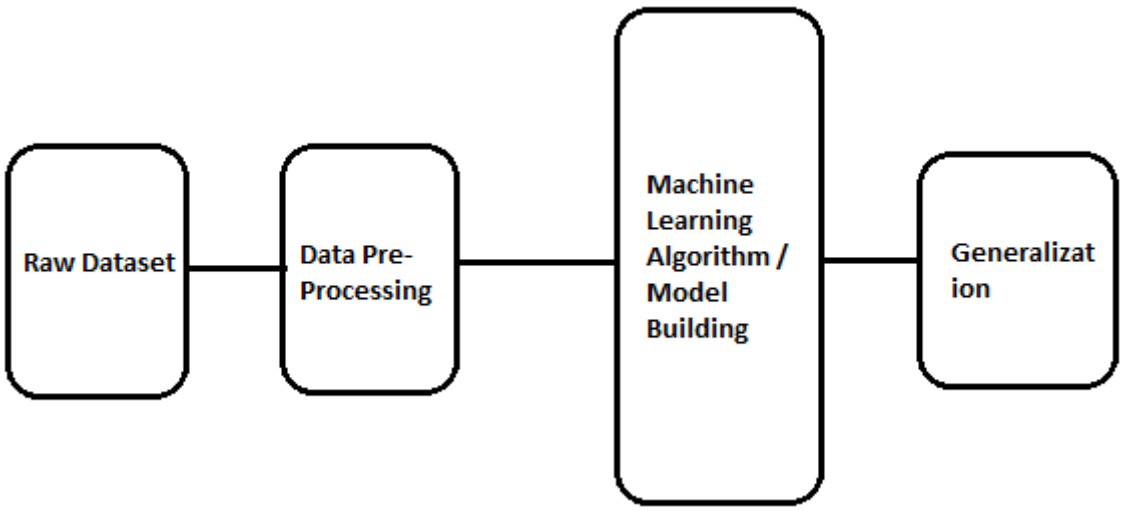

Figure 4.2: Machine Learning Process

This Figure 4.2 explains the ML process is divided into three key parts, i.e. data input, model building, and generalization. Generalization is the process for predicting the output for the inputs with which the algorithm has not been trained before. ML algorithms are mainly used to solve complex problems where human expertise fails such as weather prediction, spam filtering, disease identification in plants, pattern recognition.

4.1.4 Machine Learning in Precision Agriculture

The concept of the ML in Precision Agriculture is to operate things via smart IoT sensor, Actuator, Micro controller, Transceiver and Drones. These sensors can monitor the soil humidity, temperature, water level etc. It will analyze whether the plants requires water and it will take necessary actions by sending data to cloud.The drones check the weather , environment and rainfall for the to growth of the crops. It will irrigate the plants and spray fertilizers and manure to the plants when required.

Robots with computer vision will ensure all crops are good or it is affected by disease. It also find the weed in the farm and remove it. All the data are sent to cloud and sent to remote controlled place where all the raw data's are processed and generalization occur.

According to the data Machine Learning will classify those into different parts and search for the perfect solution. The algorithms like K-Nearest Neighbor, Random Forest, Convolution Neural Network and so., in table 4.1 searches for the better solution comparing each other. After processing it will prepare the drones according to it, like spraying antiviral agents to the crops.

Machine Learning Algorithm	Algorithm Description
KNN	KNN is a simple supervised Algorithm. In this, the labelled data set is divided into different classes based on their output. Thereafter, a new object is assigned a particular class based on k nearest neighbour.
Random Forest	Random Forest is the ensemble classification model which combines a number of decisions tree classifiers. The final class of a new object is found out based on the majority class predicted from different decision tree classifiers.
CNN	CNN is the most widely used deep neural network. This network consists of a number of layers of neurons in which network use mathematical operation convolution instead of matrix multiplication in at least one of the network layers.

Table 4.1 Machine Learning Algorithm

Finally (post-farming), it will help in livestock management and yield prediction. As it collect the data of vegetable and fruits usage, it make the farmers to plant the particular species which is in need.

Chapter 5

RESULTS AND DISCUSSIONS

5.1 Problem Faced

Farmers need to deal with many problems, including how to: Cope with climate change, soil erosion and biodiversity loss. Satisfy consumers' changing tastes and expectations. Meet rising demand for more food of higher quality. Even normal factors Irrigation on time, choosing correct fertilizers and manures, weed detection and detecting Crop disease is a major cause of famine and food insecurity around the world.

5.2 Solution

Precision agriculture using ML techniques will analyses the soil and climate conditions before farming and choose the best crop to be planted, irrigate using drones on time, detect the presence of weed and analyse the disease if crops are affected and find the best remedy using data previous data stored and from different algorithm,

Chapter 6

CONCLUSION AND FUTURE ENHANCEMENTS

6.1 Conclusion

Precision agriculture is empowering the farmers with technology intending to get optimum outputs.IoT enabled smart sensors, actuators, satellite images, robots; drones are some of the key technological revolutions. Artificial intelligence which is the automation of intelligent behavior is continuously benefiting our planet and helping humans in various aspects of life. Using ML algorithm we can find the solve all the problems faced by the farmer. Drones and robots enabled with a digital camera are employed for this work. Livestock management is an important concern for farmers across the world. Knowledge-based agriculture system efficiently handles livestock management.

6.2 Future Enhancements

As a scope of future work, NLP based chat bots can be built for farmers and more ML, DL and hybrid algorithms can be explored in the agriculture industry for sustainable use of available resources.

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