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ANALYSING THE EFFECTS OF CLIMATE CHANGE IN FLORA

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Abstract : Plants are exposed to various kinds of stress-both biotic and abiotic. Climate change imposes greater stress and adaptability problems on plants. It affects their productivity and sustenance. This is when machine learning can be effectively used to alter the climatic change effects of plants. The study has attempted to overview various aspects of how machine learning and IoT can be helpful in mitigating climatic change effects on plants across the globe.

IndexTerms - **Machine Learning (ML), Internet of things (IoT), IIoT, Climatic Change, Plants, Agriculture**

I.INTRODUCTION

Climate change refers to the change in the average conditions such as temperature and rainfall, due to natural or man-made activities. The climate of Earth has become warmer over the last decades for which, climate change and global warming is responsible. NOAA's 2020 Annual Climate Report discusses how the increase in temperature has occurred over the years. According to this report, it has increased by 0.08 degree celsius per decade since 1880. The most striking fact is that the temperature increase from 1981 onwards has been more than twice compared to this data. This change in temperature occurs as a result of greenhouse gas emissions. This has a significant effect on people and nature. Many research works are focused on the identification of solutions that helps to mitigate the negative impacts of climate change in plants. Climate change has many consequences for plants be increased flooding or droughts. Besides these effects of global warming, rising carbon dioxide concentrations, and temperature affects the plant growth, reproduction etc directly. According to the scientific reports of the Intergovernmental Panel on Climate Change (IPCC), high rise in global warming since 1950 can no longer be explained by natural climatic fluctuations. In some cases, the factors like temperature and carbon dioxide rise may results in more favourable conditions. But this is not always true in the case of plants since it has adverse effects on plants in certain regions. There are many ways to reduce the impact of climate change. The most popular ways are Machine learning and Internet of Things. The Internet of Things (IoT) generates numerous data from millions of devices.

A. MACHINE LEARNING

Machine Learning is generated by data and gives insight from it. Machine learning for IoT can be used to find future trends. Machine Learning is a branch of artificial intelligence used to identify patterns and make decisions with minimal human interventions. Machine Learning is the one of the most exciting technologies that gives data to the computer system and trained our system by building machine learning models using the data and different algorithms. ML applicable in more and more scientific fields including medicine, bioinformatics, computational chemistry, computational statistics,

neuroscience, philosophy, etc. The main goal of machine learning is to build an automated data model for analysis purposes.ML algorithms use data as input to predict new output value. It can be divided into 3 broad categories- supervised learning, unsupervised learning and reinforcement learning. Supervised learning is one of the Machine Learning model which is trained on the input data that has been labeled for a desired output. It is used for classification as well as regression tasks. Unsupervised learning: In this approach, it identifies patterns in the given data set that are neither classified nor labeled. In the previous two types, either there are labels in the dataset or no labels for the observations in the dataset. Semi- supervised learning is the middle between supervised and unsupervised algorithms. It uses a limited set of labeled dataset to shape the requirements (or we can say it train itself). Labeled and unlabeled data are combined during the training process. Reinforcement learning enables an agent interacts with the environment to maximize cumulative rewards from its own experiences. It is very similar to supervised learning but there is one major difference between them that sets them apart. In supervised learning the model learns a mapping from input to the output datasets. In reinforcement learning there are no predefined labels.

B. INTERNET OF THINGS

IoT has become one of the most important technologies over the past few years. Internet of things (IoT) is a collection of interconnected sensor devices that has the ability to transfer data over a network without requiring any human interventions. IoT plays an important role in reducing greenhouse gas emissions. IIoT (Industrial IoT) is a subset of IoT and refers to interconnected sensors and other devices for industrial applications such as manufacturing, agriculture, oil and gas and so on. Both of them can connect devices to the internet. The only difference is that IoT is used for consumer purposes while IoT is used for industrial applications. The agriculture industry makes extensive use of IIoT devices. IIoT enhances machine-to-machine communications. In many applications IoT is used to collect and exchange data. However, in order to analyze the collected data and create smart applications, human intervention is required. As the number of devices increases, the amount of collected data also increases. This is where big data has its applicability. Big data can be handled properly with conventional databases. So, special infrastructure is needed to handle such a huge volume of data and special techniques to analyze them. There are many ML algorithms that can help to deal with such cases several research works relating to this are reviewed in the next section.

II. LITERATURE REVIEW

Machine learning is a useful tool both in reducing greenhouse gas emissions and in helping society adapt to the effects of climate change. Climate change is a complex and grave issue that requires immediate attention. Both machine learning and artificial intelligence analysis can be effectively used for the studies related to climate change. But, there are limitations put forth by computational architecture and power.

In a study conducted by Chris Hauntingford and his colleague [6], the team has presented an overview about the various machine learning methods like gradient descent method, gaussian processes and nonlinear, non-gaussian inferences. They have also suggested about three applications related to this- a UK extreme event, the ‘Warning hiatus’, and terrestrial ecosystem equation building. They predict that machine learning will help in producing and refined advice about the climate situations related to higher greenhouse gas concentrations.

This study titled “Machine learning methods for crop yield prediction and climate change impact assessment in agriculture” [2], they have used two yield models, namely-parametric yield model and neural nets and semi-parametric neural nets. They have used data on on corn yield from the US midwest and found that the yield impacts projected by the neural nets are less severe than those shown by parametric models. The semi-parametric approach that works better in prediction.

“IoT for the Failure of Climate Change Mitigation and Adaptation and IIoT as a Future Solution” by Nesma Abd El-Mawla and his colleagues [19], discusses about a case study conducted by Ericsson research projects. They proposed that the ‘SMART GRID’ can be effectively used in reducing greenhouse gas emissions by 3.9 % by the end of 2030. Another report by Ericsson in 2015, it was found that reduction in greenhouse gas emissions by up to 15% can be brought about using ICT in all industry sectors by 2030. The various IoT solutions available includes Ÿ electricity distribution, Ÿ services and industry and Ÿ transport. They have also pointed out that both IoT and IIoT(Industrial IoT) can also be used in control of environmental wastes. This can be used not only for protection against rise in temperature and climate changes but also against cyber-attacks.

The paper “Machine Learning for weather and climate are worlds apart” by D. Watson- Parris [8], enlists recent technologies which in mitigate climate change includes internal variability model, model structural uncertainty, model parameter uncertainty and scenario uncertainty. The main challenges faced in this paper is that for single climate model integration there are many data. But the numbers of model samples which one might want to emulate is often small this creates a problem. An underlying training dataset is necessary, including all possible outcomes for training of climate

emulators so that nothing outside the distribution will be predicted. Larger more accurate emulators can be created using deep GPs, neural architecture search and spherical- CNNs.

In a study "A survey on plant health monitoring using IoT" conducted by Dr S Balaji and his colleagues [9], deals with detecting the risks in agriculture and also marketing of farming practices. The physical conditions like temperature, soil temperature, humidity etc in plants are monitored by IoT based observing system. In this, it also states that SVM formula isn't appropriate for big information sets. IoT based monitoring is very helpful to the farmers for obtaining the updated info.

"Promoting Greenness with IoT based Plant Growth System" by S.M Kamruzzaman and his colleagues [22], stated that by monitoring and analyzing the pH level, we can add calcium or limestone and thus a rise in pH by neutralizing the acids. Raindrops sensors are used to detect the status of rainfall ie., no rain, rain, heavy rain. The duration of raining period is also calculated from the start to end of rain. The advantage of this device is that it will be upgraded with new customized single PCB to make it more compact in size. Secondly, to get a more precise growth report, image processing system will be introduced in future. An android application will be developed alongside the website so that it can be more user friendly to use.

III. CONCLUSION

In this paper we have highlighted the role of IoT and ML in mitigating the effect of climate change with an emphasis on plants. The impact of climate change can be reduced using IoT and IIoT. We could understand from the review that new trends of IoT and ML helps to bring down the adverse effect of climate change on plants. Using ML, researchers will be better able to predict how the environment will respond to variables like carbon levels in the air, and in turn, to know what measures need to be taken to protect biodiversity.

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