INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

Impact Factor: 5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 03, March 2024, pp: 971-977

CROP RECOMMENDATION AND YIELD PREDICTION USING BEST MACHINE LEARNING PRACTICES

Sneha M S[1], S N Vedhika[2], Guru Prasath N[3], Srivasthan V A[4], Arun V[5]

[1,2,3,4,5]Department of Artificial Intelligence and Data Science Sri Sairam Engineering College Chennai, India.

ABSTRACT

Machine Learning, the innovative powerhouse of technology, has ushered in a new era of possibilities. From personalized recommendations to predicting outcomes, machine learning is the driving force behind countless advancements, promising a future where computers not only understand but also learn from the data they encounter. Over the last two decades, India has witnessed a substantial decline in the performance of a majority of its crops, attributed to the impacts of climate change. To empower policymakers and farmers with valuable insights for effective marketing and storage decisions, it becomes imperative to anticipate agricultural yield before the actual harvest. This initiative aims to aid farmers in making well-informed choices regarding crop selection and estimating yields before cultivation. The project introduces an interactive prediction system designed to address this challenge, providing farmers with accessible outcomes through an online graphical user interface. The predictive capabilities of this system leverage data analytics in agricultural forecasting, utilizing various techniques and algorithms. Our recommendation algorithm takes into account multiple parameters, including temperature, humidity, rainfall, and pH levels, as well as nutrient components like nitrogen (N), phosphorus (P), potassium (K), and moisture content. The application of data mining, a process involving the analysis of data from diverse perspectives to distill meaningful information, allows for the determination of crop yield growth. The project notably utilizes well-established and highly efficient supervised machine learning algorithms. Given that each state in India possesses a distinct soil composition necessitating varied analytical approaches, the primary objective of this initiative is to recommend optimal crop choices tailored to specific soil types. Additionally, the project endeavors to augment crop yield during harvesting, thereby offering substantial benefits to farmers. Through this holistic strategy, the project aspires to transform agricultural decision-making by furnishing farmers with cutting-edge tools capable of bolstering productivity and addressing challenges arising from climate-induced factors.

Keywords- Machine learning, Crop recommendation, Yield prediction, Supervised algorithms.

1. INTRODUCTION

At the heart of India's economic structure lies its agricultural sector, a fundamental cornerstone supporting the livelihoods of a substantial segment of the population.

However, the productivity of Indian agriculture is intricately linked to the unpredictable nature of weather patterns. The capricious weather poses a significant challenge for farmers striving to optimize crop production. Recognizing this challenge, there is an urgent need for a sophisticated system that offers timely guidance, forecasts future crop productivity, and conducts thorough analyses. In this context, the integration of historical data, advanced algorithms, predictive modeling, and machine learning emerges as a transformative solution, empowering farmers and agricultural stakeholders to make informed decisions, allocate resources judiciously, and ultimately maximize crop yields.

The journey toward an effective prediction system involves the utilization of various algorithms and their interconnections. By leveraging big data analytics techniques, the agricultural industry is broadening its horizons, embracing the potential of data-driven insights to overcome challenges. The gradual deterioration of the agricultural sector due to the adoption of unfavorable products and methods has spurred the need for innovative approaches. The shift towards artificial and hybrid goods, coupled with a lack of awareness about optimal cultivation practices, has contributed to an unhealthy lifestyle and altered seasonal climates, depleting essential resources such as soil, water, and air, ultimately resulting in food scarcity.

Amidst these challenges, strategies aimed at fostering agricultural economic growth in India are imperative. Enhancing crop yield and quality stands as a pivotal objective, and machine learning, a subset of artificial intelligence, emerges as a formidable ally in this endeavor. The proposed approach involves the development of a comprehensive prediction system that not only recommends the most suitable crops, considering external variables but also predicts the maximum achievable yield. The overarching goal is to enhance crop yields at the time of harvest, thereby contributing to food security and sustainable agricultural practices.

The recommendations generated by the system are multifaceted, aiding farmers in crucial decision-making processes. From determining the optimal planting time to advising on irrigation, fertilization, and harvesting schedules, the

system provides actionable insights. Furthermore, it extends its utility by suggesting specific crop varieties tailored to local conditions, optimizing resource utilization, and elevating overall productivity. This holistic approach not only benefits individual farmers but also holds significance at broader levels – be it at the international, regional, or local scale.

Agricultural yield prediction, a complex process, relies on a myriad of factors, including land use, soil composition, climate, and various environmental parameters. The incorporation of variables such as pH levels, nitrogen (N), phosphorus (P), potassium (K), and rainfall further refine the precision of the recommendations. The outcome is a tangible increase in agricultural quality and yields, achieved with a reduced negative impact on the environment. The significance of these advancements is highlighted by key objectives: firstly, predicting crop yield and suggesting optimal crops using machine learning techniques; secondly, creating a user-friendly interface for improved accessibility; thirdly, refining algorithms continuously to enhance the precision of crop yield predictions; and finally, analyzing various climate factors, such as cloud cover, humidity, precipitation, and temperature, to offer comprehensive insights. These objectives collectively aim to streamline decision-making for farmers, making the system more user-friendly, accurate, and insightful in navigating the complexities of agricultural practices and climate dynamics.

The integration of advanced technologies, particularly machine learning, into the realm of agriculture in India represents a paradigm shift. This transformative approach not only addresses the pressing challenges faced by the agricultural sector but also paves the way for sustainable practices, ensuring food security and economic prosperity. As the agricultural landscape evolves, the collaborative efforts of farmers, stakeholders, and technological innovators will play a pivotal role in shaping a resilient and productive future for India's agrarian economy.

A. Motivation

Indian farmers face multifaceted challenges leading to financial losses. Addressing this social issue, we propose a solution through a machine learning model. This technology aims to enhance crop yield by providing tailored recommendations for optimal cultivation based on soil types. Our initiative strives to empower farmers, enabling them to forecast and achieve maximum crop production from their fields, thereby mitigating economic hardships.

B. Problem Statement

Our goal is to develop a high-accuracy machine learning model that minimizes loss, predicting crop production based on key parameters: state, district, soil type, N, P, K levels, temperature, humidity, and pressure. Through a comprehensive evaluation of different machine learning algorithms, we aim to identify the most effective one. This model will not only suggest the optimal crop for a specific field but also forecast the highest achievable yield. By harnessing the power of data-driven insights, we seek to empower farmers with precise recommendations, contributing to improved crop planning and increased agricultural productivity.

2. LITERATURE SURVEY

The GBM Machine Learning Algorithm is used to recommend the crop, which helps in yielding a large amount of crop in the given time[1]. Random forest has greater accuracy than decision trees, SVM, and KNN, so it was chosen as the algorithm for the recommendation system in this paper's comparison of machine learning algorithms[2]. It evaluated the predictive power of three different crop recommendation algorithms—Random Forest, Support Vector Machines, and Naive Bayes—in predicting pre-season crop maps using data from the Indian government[3]. BiLSTM and MERNN Algorithms have been combined to create a completely new BiLSTM-MERNN system for agricultural output prediction and recommendation. In terms of handling overfitting problems and achieving local minima in the data, the BiLSTM-MERNN model outperforms other models[4]. To help farmers assess the many soil conditions on their land and suggest the most profitable crops that would be best for it, this article makes use of IoT, cloud computing, AI, and ML. To maximize the benefits, the performance of four supervised machine-learning algorithms—linear regression, random forest regression, decision tree, and XGBoost—has been compared[5]. AdaBoost, a machine learning algorithm, has been proposed by this research study to predict crop yield based on various parameters, including state, district, area, seasons, rainfall, temperature, and area. The Random Forest algorithm is used to recommend fertilizer[6]. The proposed system considers the N, P, K, and pH levels of the soil to predict which crops would be most productive to grow in such perfect soil conditions. Random Forest, which has a 98% accuracy rate, is used in the model's construction, while SVM has a 75% accuracy rate. The farmer can choose which crop to plant in their area with the help of the system's suggestion of a potential crop[7]. They proposed a timestamp feature variation-based weather prediction using an artificial neural network (TSFA-ANN) for successive crop recommendations in big data analysis. The forecasting predicts the upcoming dataset and supportive measures belong to the dataset based on feature selection and classification[8]. Machine learning techniques are used for the soil and crop modules, taking into

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

Impact Factor: 5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 03, March 2024, pp: 971-977

account various factors such as pH, N, P, and K. There are four different kinds of classifiers used: K-Nearest Neighbors, Decision Trees, Random Forests, and Artificial Neural Networks. With an accuracy of 98.63 percent in the crop dataset and 92.61 percent in the soil dataset, the Random Forest algorithm yields the best result[9]. The KNN algorithm is an effective tool that could help farmers choose the right crops to plant at the right time with more knowledge. With its ability to learn from past data and forecast future events, the algorithm may help farmers maximize crop yields and reduce the risk of crop failure[10].

3. METHODOLOGY

Our concept, which revolutionizes agriculture in the face of climate challenges, is an excellent instance of creativity. With the help of machine learning, we have developed a prediction system that will empower farmers in India. Our project aims to provide farmers with proactive knowledge as crop performance is impacted by climate change. Presenting an interactive yield prediction software that acts as a smart farmer's digital oracle. Not only is it data, but our suggestion system has conducted a symphony of parameters, including temperature, humidity, and soil minerals. Our project is a combination of supervised machine learning and data mining technologies. Our goal is to enable farmers to make effective agricultural decisions that will equip them against climate uncertainty.

Any machine-learning system needs data to function efficiently. In our quest to revolutionize agriculture and uplift the lives of Indian farmers, our innovative approach delves into the intricacies of each state and district. Recognizing the diverse climate patterns across the country, we meticulously sourced historical crop and climate data from various sources. These include key-factors like precipitation, temperature, cloud cover, vapor pressure, pH, and nutrient levels (N, P, K). These variables, crucial in influencing crop production, were recorded every month to capture the nuances of India's agricultural landscape.

To transform this wealth of data into actionable insights, we embraced the power of machine learning. The dataset, resembling a dynamic time series with its erratic behavior, became the canvas for our analytics. A comprehensive 70-30 split allowed us to train our model on 70% of the dataset, reserving a prudent 30% for rigorous testing.Enter the ensemble of machine learning algorithms - Random Forest, XG Boost, SVM, Naive Bayes, Logistic Regression, and Decision Tree. Like seasoned detectives, they sifted through the data, unraveling patterns, and correlations. For crop recommendations, Random Forest, XG Boost, and SVR took center stage, offering tailored suggestions based on the district's unique profile.

Apart from making predictions we also create a user-friendly web interface, which serves as a virtual oracle for farmers. This graphic interface, intuitively designed, becomes the farmer's ally, providing insights, recommendations, and yield predictions at their fingertips. Our mission is to democratize precision agriculture, making it accessible to every farmer regardless of age or technological prowess. The interface, a beacon of simplicity, ensures that the wisdom of our machine-learning model transcends generational gaps, empowering farmers from all walks of life.In this synergy of data, algorithms, and user-friendly design, we are not just predicting crop outcomes; we are sowing the seeds of economic prosperity for the farmers.

Fig. 1. System Architecture for Yield Prediction

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

Impact Factor: 5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 03, March 2024, pp: 971-977

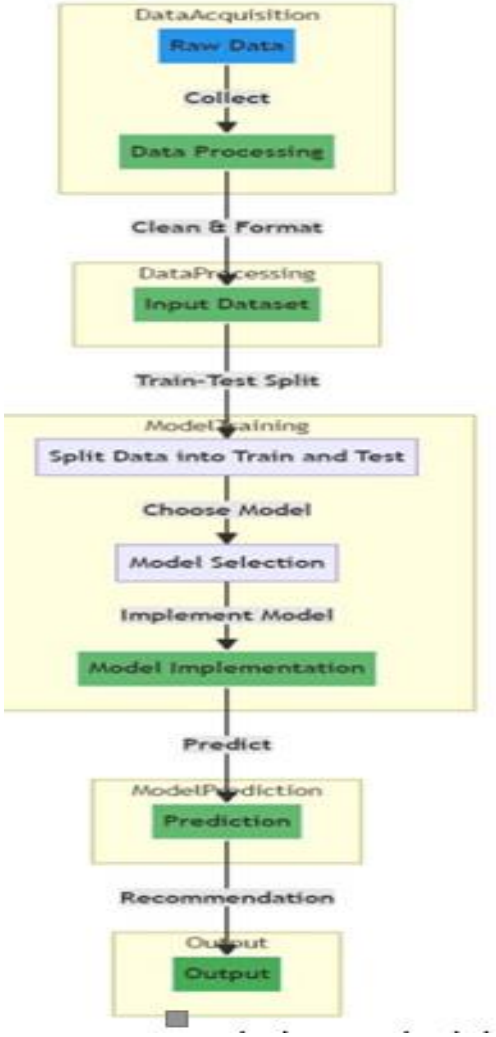

Fig. 2. System Architecture for Crop Recommendation

4. RESULT

The results show that Random Forest and SVR were the two most accurate algorithms for crop recommendation and yield prediction, with accuracy values of 0.9909090909091 and 0.9623575914308666, respectively.We have developed a user-friendly webpage that allows users to input necessary values and receive yield predictions, along with convenient crop recommendations. The interface ensures a straightforward experience. Furthermore, there is potential for integration as a Google extension in the future.

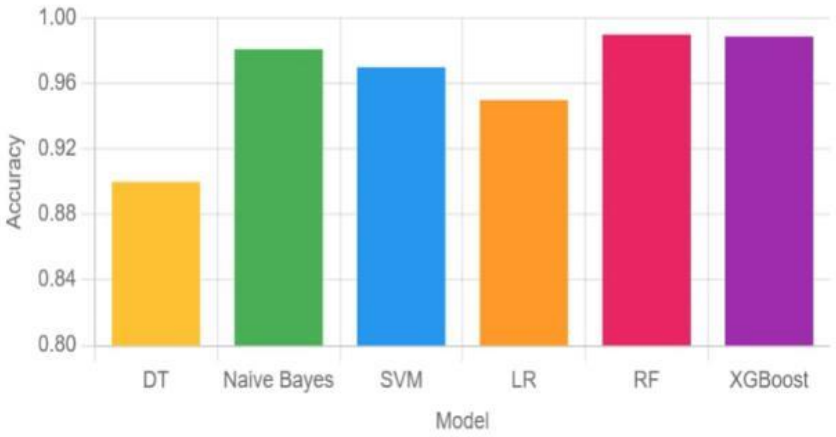

Fig. 3. Crop Recommendation

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

Impact Factor: 5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 03, March 2024, pp: 971-977

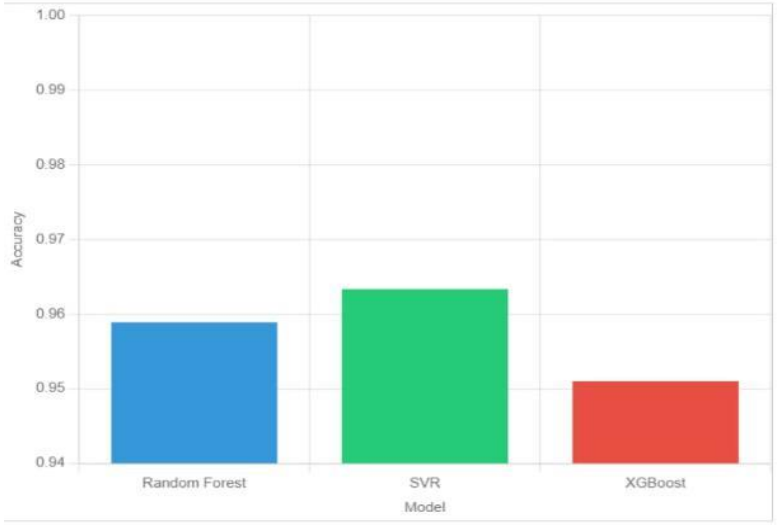

Fig. 4. Crop Yield Prediction

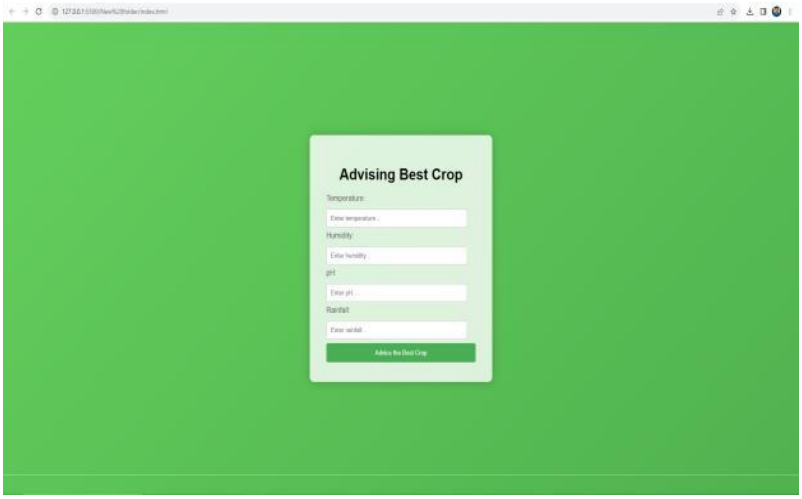

Fig. 5. User-interface for Crop Yield Prediction

Fig. 6. User-interface for Crop Recommendation

5. CONCLUSION

Based on the climatic and soil input parameters the present study shows a demonstration of the potential use of data mining techniques in predicting the crop yield. The accuracy of predictions for the developed model will be above 90 percent in all the crops. A user-friendly web page has been developed for predicting crop yield that can be used by any user of their choice of crop and also we have added a recommendation system in the web page for better crop prediction based on soil and weather parameters of the location.

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

Impact Factor: 5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 03, March 2024, pp: 971-977

6. FUTURE SCOPE

Our work on building a crop recommendation system and predicting harvests is based on several features and has great potential for further development and use cases. Our framework demonstrates scalability and adaptability, paving the way for broader utilization and future enhancements.Several promising future strategies include:

A. Developing Precision Agriculture with IoT Sensor Integration:

The incorporation of IoT sensors into agricultural landscapes, revolutionizes our research into crop yield prediction and recommendation systems. As watchful managers, these sensors transmit data in real time on vital components like temperature and moisture content of the soil, and many more. This constant stream of data improves forecast accuracy and develops into a comprehensive instrument for crop health monitoring and early pest infestation detection. Consequently, farms may eventually be networked as information-sharing ecosystems to boost agricultural output.

B. Building a Crop Disease Forecasting System:

Our technology is not just capable of yield prediction; it can also transform into a Crop Disease Oracle.We may use the system to foresee and prevent crop illnesses. Complex mathematical models utilize historical data and current environmental variables to forecast the probability of specific crop diseases. A new era of agriculture that is resistant to the attacks of dangerous ailments is being ushered in by farmers who are not only alerted but also equipped with preventative measures.

C. Climate-Resilient Agriculture:

Our project is ready to take on the challenge of agriculture under the ever-expanding shadow of climate change. Adaptive algorithms will anticipate changing climate trends and take proactive measures to adjust them. Dynamic crop variety and planting time recommendations will enable farmers to manage the risks associated with erratic weather. Essentially, our system turns into a shield that equips farmers to endure the harsh occurrences of unpredictable weather.

D. Market-Infused Intelligence:

Our technology is now a holistic platform for agricultural decision-making, rather than only a forecasting tool due to the integration with market dynamics. In addition to yield forecasts, farmers also receive market trends and pricing information. Equipped with this knowledge, they can decide with confidence when and where to sell their goods, turning our system into a symbol of the agricultural community's economic independence.

E. Smartphone Application:

Make a smartphone app that provides advice, forecasts, and latest information to farmers. This would broaden the system's user base and give farmers useful information they could apply in the field.Beyond traditional boundaries, our imagined smartphone application provides farmers with a comprehensive toolkit in addition to predictions. This application acts as a digital companion, providing real-time updates and personalized recommendations to make sure the farmer's everyday activities are seamlessly connected with the knowledge gleaned from our system. In essence, they are holding a revolution in their hands rather than merely an upgrade in technology.

7. REFERENCES

[1] R Jaichandran, T Murali Krishna, Sri Harsha Arigela, Ramakrishnan Raman, N Dharani, Ashok Kumar. Light GBM Algorithm based Crop Recommendation by Weather Detection and Acquired Soil Nutrients. International Conference on Power, Energy, Control and Transmission Systems (ICPECTS).

[2] Siva Ramakrishna Sani, Surya Venkata Sekhar Ummadi, SriRajarajeswari Thota, Nikitha Muthineni, Varun Sai Srinivas Swargam, Teja Sree Ravella. Crop Recommendation System using Random Forest Algorithm in Machine Learning. 2nd International Conference on Applied Artificial Intelligence and Computing (ICAAIC).

[3] Ramachandra A C, Garre Venkata Ankitha, Idupulapati Divya, Parimi Vandana, H S Jagadeesh. Crop Recommendation Using Machine Learning. International Conference on Data Science and Network Security (ICDSNS).

[4] J Sreemathy, N Prasath. Crop Recommendation with BiLSTM-MERNN Algorithm for Precision Agriculture. International Conference on Networking and Communications (ICNWC).

[5] Md. Delwar Hossain, Mohammod Abul Kashem, Shabnom Mustary. IoT Based Smart Soil Fertilizer Monitoring And ML Based Crop Recommendation System. International Conference on Electrical, Computer and Communication Engineering (ECCE).

[6] Jeevaganesh R, Harish D, Priya B. A Machine Learning-based Approach for Crop Yield Prediction and Fertilizer Recommendation. 6th International Conference on Trends in Electronics and Informatics (ICOEI).

[7] B Shabari Shedthi, Vidyasagar Shetty, Anusha, Rakshitha R Shetty, Anisha Shetty, B.A Divyashree Alva. Crop and Nutrient Recommendation System using Machine Learning for Precision Agriculture. International Conference on Artificial Intelligence and Data Engineering (AIDE).

[8] Ravi Kumar. Time Stamp Feature Analysis Based Weather Prediction Using Dense Hared Rate Based Classification for Successive Crop Recommendation in Big Data Analysis. International Conference on Distributed Computing and Electrical Circuits and Electronics (ICDCECE).

[9] A. Jhansi Swetha, G. Kalyani, B. Kirananjali. Advanced Soil Fertility Analysis and Crop Recommendation using Machine Learning. 7th International Conference on Trends in Electronics and Informatics (ICOEI).

[10] Sivanandam K, Prasanth M, Naveen B, Saran S. An Efficient Machine Learning Approaches for Crop Recommendation based on Soil Characteristics. Second International Conference on Electronics and Renewable Systems (ICEARS).

[11] S. Thirumal, R. Latha. Automated Rice Crop Yield Prediction using Sine Cosine Algorithm with Weighted Regularized Extreme Learning Machine. 7th International Conference on Intelligent Computing and Control Systems (ICICCS).

[12] Anıl Suat Terliksiz, D. Turgay Altýlar. Use Of Deep Neural Networks For Crop Yield Prediction: A Case Study Of Soybean Yield in Lauderdale County, Alabama, USA. 8th International Conference on Agro-Geoinformatics (Agro-Geoinformatics).

[13] Avdesh Kumar Sharma, Anand Singh Rajawat. Crop Yield Prediction using Hybrid Deep Learning Algorithm for Smart Agriculture. Second International Conference on Artificial Intelligence and Smart Energy (ICAIS).

[14] Mullangi Ramu, Javvadi Teja Sri. Wheat yield prediction using Artificial Intelligence models and its comparative analysis for better prediction. International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE).

[15] R Anand, Abhishek Krishna V P, Dhanesh U M, Gowtham Vas. Secured agriculture crop monitoring using Blockchain. International Conference on Power, Energy, Control and Transmission Systems (ICPECTS).