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A Review of Iot-Based Technologies for Identification and Monitoring of Rice Crop Diseases

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Abstract: Paddy is one of the main crops throughout the world. It plays the role of important food crops in most parts of Asia (Chen et. al.). Paddy is prone to a lot of diseases so there is a need of proper monitoring system to monitor the paddy crop during its production. There are three stages of production of paddy i.e.Vegetation, reproductive and ripening. The field of IoT helped a lot in the development of monitoring system to detect the growth as well as diseases of rice crops. This article solely focused on the review or study of different articles which proposed different monitoring and detection system for monitoring of rice crop. To conduct the study different papers have been reviewed and found that there are a lot of devices present to detect the crop production but none of them are 100 percent accurate.

Keywords: Rice, Monitoring, agriculture, IoT, Paddy Diseases

I. Introduction:

Paddy (Rice) is the staple crop in mos part of the world. It is one of the most significant crops in Asia and is produced on a very large scale. It is also known as a flooded crop as it is grown on a waterlogged soil. Paddy (Rice) or rice is a rich source of carbohydrate and its crop also releases a high amount of methane gas. Rice is a kind of crop which gets affected by diseases and suffer a loss in yield. There are nine types of diseases which affect the rice, it may be because of bacteria or fungi. Nowadays there are a lot of techniques present to monitor the rice plant but still either equipment is costly or unaffordable or not effective for every field. In this article, authors are trying to review the researches which proposes the monitoring and detection system of diseases in rice plant. As it is known that rice is a vital crop so proper monitoring is needed for rice so that farmers can get almost all the production or in other words farmers could suffer minimal loss. The basic task of the monitoring system is to monitor the plant and give a proper report about its growth at different stages of production i.e. vegetation, production and ripeness (Fig. 1).

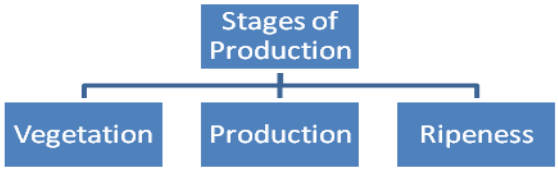

Fig. 1: Stages of production of Paddy crop

In most of the countries rice production plays an important role in food security and economic balancing. For instance, let's take the example of Vietnam where 50% of the gross production of crops is rice (Chen et. al. , 2007). So Vietnam needs a proper monitoring system to monitor the growth of rice and it also needs a detection system for the detection of diseases in rice.

With the introduction of IoT in agriculture, agriculture becomes more efficient and more precise. It helped this sector a lot by making the farming process more efficient and accurate. It helps monitor the farming land and then deciding the proper area for the production of crops. As it is known that agriculture is not a very promising occupation so farmers cannot take any chance in the production of crops and this is one of the reasons for an efficient monitoring system. Despite proper monitoring and detection of plants there is a chance of less growth and farmer can earn less, so, there is a need for a system in which farmers incur less loss and more production of crops.

Why Monitoring is important?

As paddy is the most essential crop so it needs monitoring to find out the proper growth of the plant. Monitoring helps researchers in finding the effect of different weather conditions on plants. Normally farmers adopt open eye monitoring of plants but one should focus on various technologies present around the globe like remote sensing, image processing, etc.

In this article authors have reviewed around 20 articles and tried to find out the best system for the monitoring of rice plants.

II. Literature Review:

In the year 2007 Chen et. al. [1] presented a neural network approach for monitoring of rice crops. The neural network acted as a tool for monitoring of crop. For the proposed prototype the author collected the data directly from the field and with the help of

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image processing he monitored different stages of plant production. Using the prototype the author examined the plant at three different phase's vegetative reproductive and ripening.

In 2008, Oza Et.al. [2], designed and developed a model with active and passive micro rate remote sensing data for monitoring of rice plant. The microwaves have unit target interaction as well as all-weather capability. These devices are comfortable in handling and for result generation.

In the year 2018 Ali et.al, [3], designed an agricultural monitoring system using different kinds of sensors and devices for monitoring of the crop. These devices help in intrusion detection, pest detection weather detection and also have water and soil monitoring module.

In the year 2019, Minh. et.al. [4], proposed a monitoring system for precision agriculture of rice in which the land will be properly monitored with the help of the Global Positioning System and Global information system and then a proper area will be decided for the production of rice. He also calibrated the remote sensing which will be quite helpful in the development of the monitoring system.

Taberner et.al. [5], in 2019, also worked on the rice monitoring system. But his approach was different from the approach of other authors. He focussed on the leaf area index and collected the data through satellite centers and then analyzed it. The system proposed by him is good and can be helpful in monitoring of rice plant in different climatic conditions.

In the year 2019, Lubis et.al. [6] also focussed on the monitoring of rice plants at different production stages. He used Raspberry pi as a microcontroller sensor to develop the system. The proposed model was a well-developed model which can monitor the rice plant at vegetation, production and ripeness stage.

In the year 2019, Ortiz et.al. [7] focussed on using the decision support system in controlling and monitoring of crops. He collected real-time data and then used it in developing the device for monitoring of plants. In the same year, Rudiyanto et.al. [8] proposed a system for real-time monitoring of crop using clustering. The proposed model by the author was a well-developed model which can monitor the rice plant at vegetation, production and ripeness stage.

Dirgahayu and parsa, in the year 2019[9] researched to investigate paddy growth at different levels of production. The author conducted the research directly in the field and monitored the plant growth. His proposed system was operated by collecting the satellite data. He used both optical and radar data because optical data is not useful in the case of cloudy season.

In 2019 Sangeeta et.al.[10], focused on monitoring of crop system by using different kinds of sensors including power supply microcontroller board LCD soil moisture and temperature. The developed system is a field-based device that can directly work from the paddy field.

In the year 2019 Nivedita et.al.[11], focused on diseases of plant and its detection at the earliest stage. She focused on the leaf of the plant to detect diseases. She proposed automatic diseases of plant diseases using image processing technique. With image processing the author captured the image of the leaf surface and then analyzed it with the symptoms of different diseases. By matching the symptoms a result will be generated on the screen showing the name and type of disease.

Chen et.al. in the year 2019[12], focused on rice blast disease detection using IoT and Artificial intelligence. The author named his proposed technique as riceTalk. This device monitors a paddy block and detects the diseases. The riceTalk system is an intelligent system that can detect rice blast with no image data.

Zhang et.al., in the year 2019[13], focused on monitoring the rice plant by using remote sensing technology. The remote sensing technology detects the plant damages, diseases and pest control. The diseases were further categorized depending upon their symptoms. It has an image-based feature.

In the year 2019[14] Nidhis proposed a system to detect different types of paddy diseases. The most important feature of the device developed that it can classify and diagnose the disease. The type of disease and the severity of infection can be properly examined with the help of a developing device. The image processing technique is the base of the above-proposed system.

In the year 2019[15], Shrivastava focused on rice plant disease and its detection using deep learning. The author was mainly concerned for three kinds of diseases; rice blast, leaf blight and sheath blight. The proposed system has features like image requisition, image recognition, etc. The deep learning technique used by the author combines the symptoms and classifications of the three kinds of diseases.

Gupta et.al., in the year 2019[16], focused on all the diseases caused by a pathogen. The author focused on false smut or green smut. The author used two kinds of sensors; one for humidity and another for temperature. The developed model works like a prediction system and helps in forecasting of disease before it is spread.

Devi et.al., 2019[17], worked on disease recognition of paddy crops. The author proposed a system for detection and classification of disease, it has the features like image acquisition, image pre-processing and image segmentation. It has an accuracy rate of 98.30. The image processing technique holds a strong hand in the detection of rice diseases.

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Bhattacharya et.al., 2020[18], designed a system for analyses and recognition of plant diseases. His main aim was to design a system, which can perform disease recognition without any external hand. He used a deep learning approach with image processing to automatically classify rice leaf diseases.

In the year 2020, Ennouri et.al.[19], proposed a system for crop pest monitoring and management of the crop. He used vegetation indices such as the leaf area index with remote sensing technology to detect the plant disease. The remote sensing technology apart from image processing is one of the best techniques for plant disease detection.

In the year 2020, Das et.al.[20], worked a system for prediction of rice disease by using graph-based clustering and feature selection. This technique gives a proper result by predicting the name of the disease; it is also helpful in the classification of diseases. In this device a disease data set is prepared and then diseases were classified.

III. Findings:

After reviewing 20 pieces of relevant literature, the sample size was deliberately chosen to provide a diverse yet manageable overview of current technological advancements in agriculture. The selection aimed to include a balanced representation of different methodologies and technologies, such as image processing, remote sensing, IoT, and AI-based systems, used in both monitoring and disease detection in crops. Through this literature, it was found that while every author claims the effectiveness of their proposed solution, significant gaps and challenges still remain in the cultivation process. Some authors focused specifically on the leaf area index (Ennouri et al.), while others explored the use of remote sensing technologies (Oza et al., Minh et al., Zhang et al., Ennouri et al.) to monitor and detect plant issues.

A notable observation is that a majority of the studies incorporated image processing techniques (Chen et al., Nivedita et al., Zhang et al., Nidhis et al., Shrivastava et al., Devi et al., Bhattacharya et al., Ennouri et al.), indicating its significant role in effective plant monitoring. Additionally, the detection of rice diseases was highlighted as a critical area, given rice's global importance. One study introduced RiceTalk (Chen et al.), an innovative system using IoT and AI for plant monitoring and disease detection without relying on image processing. Another study (Dirgahayu and Parsa) combined optical and radar data to overcome the limitations of weather-dependent monitoring, emphasizing the complementary nature of these technologies. The authors found that there are many devices present to assist in agriculture, for both monitoring and disease detection phase. Every author claims that the device developed or the concept developed will help in agriculture but still one can find a lot of space and problems in the cultivation process. Some of the authors focussed on leaf area index(Ennouri et.al.) while some of them are using remote sensing technology(Oza et. al.) (Minh et. al.) (Zhang et.al.) (Ennouri et.al.) to monitor and detect the plant problems. One of the important fact discovered is that most of the authors preferred image processing (Chen et. al.) (Nivedita et.al.) (Zhang et.al.) (Nidhis et.al.) (Shrivastava et.al.) (Devi et.al.) (Bhattacharya et.al.) (Ennouri et.al.) so researchers can say that it is one of the best technology helping in the monitoring of plants.

Apart from the above issues, the detection of rice diseases is also important as rice is the most consumed crop around the world. So, authors came across a technology known as riceTalk(Chen et.al.) which is using IoT with artificial intelligence to monitor the plant and detect the disease and its most important part is that it is not using image processing to detect disease or monitor plant. One author used optical and Radar data for monitoring the different levels of reproduction of plants (Dirgahayu and Parsa). The author used both kinds of data because optical data is only useful when there is clear weather while radar data can be helpful in all weather and climatic conditions.

After going through the above pieces of literature it was also found that different authors worked on different aspects of plants like monitoring, Disease detection and cure of plants from diseases. The findings of the above pieces of literature is mentioned in the below table:

Table 1: List of technologies and Findings

S. No.	Author	Year	Technology used	Finding
1.	Chen et.al.	2007	Neural Network Approach and Image Processing	Used technology for monitoring of crop
2.	Oza et.al.	2008	Remote Sensing	Used technology for monitoring of crop
3.	Ali et.al.	2018	Used different Kind of sensors and devices	This technology can be used for intrusion detection, pest detection weather detection and monitoring.
4.	Minh et.al.	2019	Remote Sensing, GPS, and GIS	Used the technology for precision Agriculture

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5.	Taberner et.al.	2019	Satellite Data	Monitoring of crop using leaf area Index
6.	Lubis et.al	2019	Raspberry pi as Microcontroller	Monitoring of Rice Plant
7.	Ortiz et.al.	2019	Decision Support System	Monitoring of Crop
8.	Rudiyanto et.al.	2019	Clustering	Monitoring of rice crop at different stages of plant production
9.	Dirgahayu and Parsa	2019	Satellite data collection (Optical and Radar Data)	Monitoring of plant growth at different stages of production.
10.	Sangeeta et.al.	2019	Used different Kind of sensors and devices	Monitoring of Rice Plant
11.	Nivedita et.al.	2019	Image processing Technique	Plant Disease Detection
12.	Chen et.al.	2019	IoT and Artificial intelligence	Rice Blast Disease Detection
13.	Zhang et.al.	2019	Remote Sensing	Detection of plant Damage, diseases and pest control.
14.	Nidhis et.al.	2019	Image Processing	Detection of Paddy Diseases
15.	Shrivastava et.al.	2019	Deep Learning	Detection of three kinds of disease: Rice Blast, Leaf Blight and Sheath Blight.
16.	Gupta et.al.	2019	Two kinds of sensors: temperature and humidity	Prediction of disease.
17.	Devi et.al.	2019	Image Processing	Disease Recognition
18.	Bhattacharya et.al.	2020	Deep learning with image processing	Analyses and recognition of plant diseases
19.	Ennouri et.al.	2020	Remote Sensing	Crop pest monitoring and management
20.	Das et.al.	2020	Graph-based clustering and feature selection	Prediction of disease

IV. Conclusion:

After going through the above literature author conclude that there is need of more research for the development of IoT devices to detect the rice diseases and for monitoring of plant, as most of the devices present today are not practical to use or even costly which a farmer cannot afford. The farmers of Asian countries like India, Vietnam, Pakistan, Srilanka, etc. are rather poor or have little support from the government regarding technologies and so farmers cannot spend a lot on purchasing devices for monitoring for rice crops. In Vietnam the total share of rice is 50% (Minh et. al.) of total crop production so farmers of Vietnam moved toward precision agriculture.

The author also concluded that with the increase of population the consumption of rice will increase so the focus on the technologies which will help in increasing the production by properly monitoring the rice crop.

References:

1. C. Chen & H. Mcnairn (2006) A neural network integrated approach for rice crop monitoring, International Journal of Remote Sensing, 27:7, 1367-1393, DOI: 10.1080/01431160500421507
2. Oza, Sandip & Panigrahy, S. & Parihar, J.. (2008). Concurrent use of active and passive microwave remote sensing data for monitoring of rice crop. International Journal of Applied Earth Observation and Geoinformation. 10. 296-304. 10.1016/j.jag.2007.12.002.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIII, Issue V, May 2024

3. Ali, Terteil. (2018). Precision Agriculture Monitoring System using Internet of Things (IoT). International Journal for Research in Applied Science and Engineering Technology. 6. 2961-2970. 10.22214/ijraset.2018.4493.
4. Minh N. D. , Son Dong Hoang, Trinh Mai Van, (2019), a review of precision agriculture In rice production in Vietnam, International Workshop On Icts For Precision Agriculture, 6 - 8 august 2019 Mardi Headquarters, Selangor, Malaysia
5. Campos-Taberner, Manuel & García-Haro, Francisco & Camps-Valls, Gustau & Grau-Muedra, Gonçal & Nutini, Francesco & Crema, Alberto & Boschetti, Mirco. (2016). Multitemporal and multiresolution leaf area index retrieval for operational local rice crop monitoring. Remote Sensing of Environment. 187. 102 - 118. 10.1016/j.rse.2016.10.009.
6. H Lubis et al 2019, Monitoring System of Rice Plant Growth Using Microcontroller Sensor J. Phys.: Conf. Ser. 1235 012116
7. Lagos-Ortiz, Katty & Medina, Jose & Alarcón-Salvatierra, Abel & Morán, Manuel & Javier, Del Cioppo Morstadt & Valencia-García, Rafael. (2019). Decision Support System for the Control and Monitoring of Crops: Second International Conference, CITAMA 2019, Guayaquil, Ecuador, January 22-25, 2019, Proceedings. 10.1007/978-3-030-10728-4_3.
8. Rudiyanto, Rudiyanto & Minasny, Budiman & Shah, & Soh, & Arif, & Setiawan, Budi. (2019). Automated Near-Real-Time Mapping and Monitoring of Rice Extent, Cropping Patterns, and Growth Stages in Southeast Asia Using Sentinel-1 Time Series on a Google Earth Engine Platform. Remote Sensing. 11. 1666. 10.3390/rs11141666.
9. Dirgahayu, Dede & Parsa, I. (2019). Detection Phase Growth of Paddy Crop Using SAR Sentinel-1 Data. IOP Conference Series: Earth and Environmental Science. 280. 012020. 10.1088/1755-1315/280/1/012020.
10. Sangeetha K., Santosh A. Prabeeda S.S. Selvamani T.(2019), Paddy Monitoring and Management System, International Journal of Applied Engineering Research ISSN 0973-4562 Volume 14, Number 5 (2019) pp. 1045-1048
11. Niveditha, P. & Gururaj, H. & Janhavi, V.. (2019). An Analysis of Various Techniques for Leaf Disease Prediction: Proceedings of IEMIS 2018, Volume 3. 10.1007/978-981-13-1501-5_19.
12. Chen, Wen Liang & Lin, Yi-Bing & Ng, Fung Ling & Liu, Chun-You & Lin, Yun-Wei. (2019). RiceTalk: Rice Blast Detection using Internet of Things and Artificial Intelligence Technologies. IEEE Internet of Things Journal. PP. 1-1. 10.1109/JIOT.2019.2947624.
13. Zhang, Jingcheng & Pu, Ruiliang & González-Moreno, Pablo & Yuan, Lin & Wu, Kaihua & Huang, Wenjiang. (2019). Monitoring plant diseases and pests through remote sensing technology: A review. Computers and Electronics in Agriculture. 165. 104943. 10.1016/j.compag.2019.104943.
14. Nidhis, A. & Pardhu, Chandrapati & Reddy, K. & Kaliyaperumal, Deepa. (2019). Cluster Based Paddy Leaf Disease Detection, Classification and Diagnosis in Crop Health Monitoring Unit. 10.1007/978-3-030-04061-1_29.
15. Shrivastava, Vimal & Pradhan, Monoj & Minz, S. & Thakur, M.. (2019). RICE PLANT DISEASE CLASSIFICATION USING TRANSFER LEARNING OF DEEP CONVOLUTION NEURAL NETWORK. ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. XLII-3/W6. 631-635. 10.5194/isprs-archives-XLII-3-W6-631-2019.
16. Gupta, Aman & Paudel, Jiwan & Yadav, Dipak & Kumar, Devansh & Yadav, Ramu & Kumar, Shrvan. (2019). Eco-friendly Management of False Smut (Ustilaginoidea virens) of Rice. International Journal of Current Microbiology and Applied Sciences. 8. 388-396. 10.20546/ijcmas.2019.811.049.
17. Devi TG, Srinivasan A, Sudha S, Narasimhan D. Web enabled paddy disease detection using Compressed Sensing. Math Biosci Eng. 2019 Aug 23;16(6):7719-7733. doi: 10.3934/mbe.2019387. PubMed PMID: 31698636.
18. Bhattacharya, Shreyasi & Mukherjee, Anirban & Phadikar, Santanu. (2020). A Deep Learning Approach for the Classification of Rice Leaf Diseases. 10.1007/978-981-15-2021-1_8.
19. Ennouri, Karim & Triki, Mohamed & Kallel, Abdelaziz. (2020). Applications of Remote Sensing in Pest Monitoring and Crop Management. 10.1007/978-981-13-9431-7_5.
20. Das, Ankur & Dutta, Ratnaprava & Das, Sunanda & Sengupta, Shampa. (2020). Feature Selection Using Graph-Based Clustering for Rice Disease Prediction. 10.1007/978-981-13-9042-5_50.
21. Kaur, M., & Mohana, R. (2018). A Software Agent Based Technique for Load Balancing in Partitioned Cloud. International Journal of Engineering & Technology, 7(4.12), 13-19.
22. Saini, G. S., Sharma, C., & Singh, G. (2017). Enhanced VHD Making Algorithm for 4G Heterogeneous Networks (Only Abstract).
23. Thakur, H., & Singh, G. (2016). Privacy and Ownership Protection Digital Data Techniques: Comparison and Survey. Indian Journal of Science and Technology, 9(47).
24. Sandhu, A. S., & Kalra, G. S. Survey of Microscopic Image Segmentation Techniques and Image Quality Measures.
25. Singh, M., Kaur, N., Kaur, A., & Pushkarna, G. (2017). A Comparative Evaluation of Mining Techniques to Detect Malicious Node in Wireless Sensor Networks. International Journal of Cyber Warfare and Terrorism (IJCWT), 7(2), 42-53.
26. Kaur, N., Kaur, A., Singh, M., & Pushkarna, G. (2017). Detection of black hole node in wireless sensor networks using DSR protocol
27. Kaur, A., Kaur, N., Singh, M., & Pushkarna, G. (2016). Sensor Integrated RFID Basedpostal Letter Tracking System