Self Learning Approach for assessing the potential for pesticide for diagnosis of diseases on Crops

Subhangi A. Shinde
HOD, Dept of MCA,
G.H.Raisoni College of Engg & Mgt,
Wagholi, Pune

Santosh Bothe
Dept of MCA,
G.H.Raisoni College of Engg & Mgt,
Wagholi, Pune

ABSTRACT

Timely estimation and diagnosis of crop diseases is very critical for the higher yield of the crop. In current scenario identification of disease is done by few experts available having experience and most of the cases farmers generally rely on insecticide/pesticide vendors advices which is generally focused towards profit making rather than scientific approach. Another case is many farmers try to apply the successful case of their neighbor farmers irrespective of neighbor's various important factors like type and age of crop, type of diseases, type soil etc as these factors are having very crucial. This approach is not a right approach in scientific view but this is the common practice in Indian agriculture system. The main reason for this is unavailability of the experts and lack of the resources. Our aim is to bridge this gap of knowledge and availability of expertise by developing the self learning system. During our interactions with farmers we understood the reason for non scientific approach due to a lack of knowledge or lack of availability of expertise. The objective of the paper is to address both the issue by making a self learning system to bridge the gap. The interpretation, analysis of defected image content is subjective. A self learning approach by automating symptoms detection will help to address the problems effectively. This self learning system has many secondary advantages beside the diagnosis like identification of severity of diseased crop, crop management system, reminder and information system, advisory system etc. Automated system will ensure accurate and timely diagnosis as per need.

Keywords

Automated disease diagnosis of crops, self learning approach, machine vision in agriculture.

1. INTRODUCTION

India is urbanizing fast, but some 73% [2] of the population still lives in rural areas. India is still a land of small-scale farmers: about half of all farms are less than 1 ha in size, and another 20% are less than 2 ha [2] Pests appear in quick succession in the various stages of growth of the plant. Increasing reliance on pesticides have replaced traditional methods that include a variety of labor intensive practices like hand picking to remove pests and cultural practices like intercropping, crop rotation, and the burning or removal of residue from the soil. Modern agriculture practices in India use chemical pesticides and fertilizers to boost the productivity since the first green revolution. Improper and unsafe use of these pesticides is harmful for environment and human health. Indian farmer is using wide ranges of chemical pesticides to limit the losses from pests and diseases, in which insecticides account for 73%, herbicides14%, fungicides 11% and other2% [3].

According to an article in TNN "A train ride to cancer care" Nandita Sengupta, Aug 16[4], the lush fields of Punjab hide a scary tale. Farmers live in a disturbing cesspool of toxicity, a result of excessive and unregulated use of pesticides and chemical fertilizers. Punjab farmers' use of pesticides is 923 g/ha, way above the national average of 570 g/ha (grams per hectare). Malwa is also Punjab's cotton belt; cotton crops are prone to pests. Farmers here use at least 15 different pesticide sprays. According to article every village with a population 3000 to 5000 has at least 30 cancer cases in a period of 1 to 2 years.

Although high use of pesticides has boosted the production of agriculture it has adverse effect on soil water and environment. Long term use of pesticides highly affects physical, chemical and biological properties of soil.

A documentary by Ramesh Memon [5] 'Slow Poisoning of India' talks of the excessive use of chemicals, chiefly pesticides, in Indian farming and how it has led to various issues. It takes us to one particular area in Kerala – Kasaragode where endosulfan was sprayed on the cashew crops aerially without any proper preparation of the villages and the villagers. This resulted in horrifying effects on the population of the area, namely various birth defects like mental retardation, cancer, cerebral palsy, congenital diseases, etc. The chemical affected the central nervous system of other children and villagers as well with some dying due to cancer. The repercussions of that dusting still continue to be witnessed in these villages.

The traditional agriculture which was way of life is now becoming a business proposition for Indian farmers. Naturally in the process of increasing the cash crop, farmers are using heavy doses of pesticides without actually knowing the quantity to be used. Excessive use of pesticides for plant diseases treatment increases the danger to toxic residue level on agricultural products. The excessive use of pesticides not only deteriorating soil but it is slowly finding way into our food, which is slowly poisoning us.

Traditional inspection of diseases on the plant is performed by human experts. The naked eye observation method is followed by these experts to identify the severity of the disease. But it is very difficult for human being to predict the exact damage that disease has done to the crop. Similarly these experts are not available round the clock for identifying these diseases in remote locations. Even if the experts are available the exact amount of pesticides required for these crops depending upon their damage is very difficult to predict. We hereby proposed a system 'Unsupervised self learning approach for assessing the potential for pesticide in diagnosis of crops'. The said system will identify the severity of the crop and depending

upon that will provide expert advice to the farmers regarding good agriculture practices (GAP).

In India rural population is dependent on farming. The problems faced by these farmers are

- Small land holdings
- Lack of technical expertise.
- Knowledge and technical gaps.

Agriculture requires information and application of knowledge from different interacting fields. A successful decision making depends on application of knowledge. In India farmers are not technologically sound. Similarly human experts are not available or may not be accessible all the time to farmers. Even if they are available because of small land holdings of the farmers, consultation becomes expensive.

With low cost mobile handsets and increased network of mobile providers in remote locations, the technology can bring sustainable solutions and services to the people. With mobile devices playing significant role in our day to day activities, it provides a great opportunity for timely and specific information to assist with crop management decisions.

2. OBJECTIVE

To design a self learning system to provide

i) Advice related to disease to the farmers anytime, anywhere on their mobile handset through SMS system in their local language with available infrastructure available.
ii) Based on the stage of disease (initial, middle, advance) amount of pesticides to be used.
iii) Develop a knowledge base for decision making process.
iv) To install remote sensors and based upon that to identify soil moisture, leaf wetness, count no of insects to transfer farmer's environment to expert system.
v) To test the developed system in the field.

3. LITERATURE REVIEW

Mohammed El-Helly et al. [6] has developed a novel approach where expert system can reach a correct and accurate diagnostic . The expert system extracts symptoms from the defected images and applies the reasoning process while taking into account extracted symptoms. The expert system developed integrates image analyzer within a diagnostic expert model through a real life example. The system developed is computer based system wherein training will be required to be given to users. Similarly the present system just identifies disorders from the leaf. It does not identify abnormalities on other parts of the plant such as fruits, stem and root. The system was for standalone platform and cannot be extended in a network and mobile environment. The system still requires human intervention after image is taken.

V. Lo´pez-Morales a, O. Lo´pez-Ortega , J. Ramos-Ferna´ndez , L.B. Mun in [7] proposed design and implementation of Integral Intelligent system which is called JAPIEST. The system focused on prevention, diagnosis and control of tomatoes which affect tomatoes. This novel tool enabled farmers to make an early decision of the candidate disease and then apply suitable control treatment, based on Integrated Pest Management. Access of this system is possible through internet. It is a rule based system wherein knowledge acquisition and representation is done through domain experts. In user module user is asked about the general plant conditions and environmental conditions. As it is internet based system user of the system should have knowledge of internet. Similarly user is required to give correct input to the system

In [8] S.S. Abu Naser etc. designed and developed an expert system with two different methods for diagnosing plant diseases. In the first method a person will provide gradual description of the plant symptoms which are fed to the system. The expert system will make a suitable decision based on the symptoms. Second approach he designed is Graphical Representation of the System. In this method, decision making process is based on the stored pictures of diagnosed cases. The system allows user to browse the cases that are similar to the requested case. System will compare the symptoms of requested case with stored one. The system will process user's choice and make a suitable decision.

Dearden etc [9] developed Kheti:mobile multimedia in an agricultural co-operative, which is mobile phone based, multimedia communication system to support sharing of agricultural knowledge and advice within a producer's cooperative. The system works as follows. A munna or service provider who will have a camera phone is appointed for village. Munna is responsible for the villages within a 5 km radius of their home and expected to visit each village at least once per week. Munna creates SDS with his mobile phone and upload it. The SDS is uploaded to the central server. The agricultural advisor would check his web-based inbox each evening, call munnas who had sent the message and arrange appointment with the farmer following day.

aAQUA [10], which stands for almost All Questions Answered, is an online Question & Answer and community discussion forum for creating and delivering information relevant to farmers. It allows members using a web browser on a computer to create, view and manage content in local languages (Hindi, Marathi and Kannada). On aAQUA, content is organized in the form of discussion fora based on the types of categories of queries posted by farmer or experts. aAQUA Photo Capture allows a user to upload photos from his field to the aAQUA server and request diagnosis by the aAQUA expert.

TCS' Mobile Agro Advisory System (mKrishi)[11] connects farmers with an ecosystem that empowers them to make sound decisions about agriculture, drive profits and conserve the environment. Farmers can send queries in a local language by keying of selecting menus. With the help of IVR technologies the software can also transport voice messages between farmer and the expert. The software also enables farmers to send crop images to experts to understand the problem better.

Web based expert system for diagnosis of micro nutrients deficiencies in crops[12] is based on deductive inference and its theory base if order of first logic. Authors have developed a decision tree which is generated from literature and interviews with experts. This decision tree works as a knowledge base for the system. The expert system infers the knowledge on diagnosis of nutritional deficiency diseases in crops, which are specific to each nutrient element. will help the ultimate user to find remedies to correct the deficient plants by exerting a control on specific parameters. The system is web based.

4. PROPOSED SYSTEM

Pesticides are used to overcome pest problems in various crops. If these pests are managed at proper time it will increase crop productivity.

What makes pesticide use hazardous?

a) Farmers poor knowledge about pesticide application: Most of the farmers in India are uneducated. Farmers apply insecticide without knowing population of insect pests, natural enemies and crop condition. Due to lack of knowledge they select wrong insecticide or use leftovers.

b) Traders act as a middlemen and technical advisors: Traders provide the farmers with chemical fertilizers, and insecticides on credit on the promise of purchase of the crop. The dealers themselves had little technical knowledge about pesticides. They merely passed on promotional information from multinational chemical companies that supplied their products. Farmers depend upon traders for advice, credit and marketing without any other alternative.

c) Use of pesticide at improper time: With irregular monitoring of the field, farmers apply the pesticide when the damage is already done to the crop. The weaker pests get killed but left ones become more resistant to pesticide, which require repeated spread of pesticides.

d) Catastrophic effect of pesticides on health:Farmers work barefoot, barehanded, wearing only short-sleeved cotton tee shirts and dhotis, which exposes them to pesticides for three to four hours at a time through leaking spray equipment, dripping plants and wind drift. Concentrated chemical products are mixed with water with bare hands. This exposure develops chronic health problems such as headaches, nausea, skin rashes, fatigue, depression, and visual complaints became common, and sometimes there was permanent nerve damage or death.

Mobile devices are playing a significant role in our day to day activities. These devices have penetrated in rural areas also. More Indians have mobiles than access to toilets [15].The increasing penetration of mobile networks and handsets in India presents an opportunity to make information related to pest control more widely available in regional language. Mobile devices can be useful to bridge the gap between the availability and delivery of agricultural inputs. Crop losses can be prevented by use of mobile devices. So the proposed decision support system is designed in such a way that with click of mobile camera farmers can send their images for consultation and obtain information regarding diagnosis in local language and right treatment for the same.

Access to the system is possible via mobile phones or through dedicated computer which is available at village panchayat office. A user can capture the image of diseased plant through his mobile phone. This image is then sent to centralized server via MMS or user can upload the same image via a computer at village panchayat's office. After receiving the image the inference engine at central server processes the image. By identifying the pattern of the

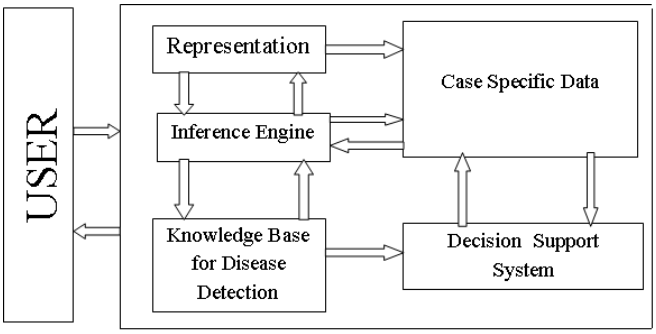

Fig1: Self-learning system approach

image at central server decision regarding type of disease, its stage and action to be taken will be given to the user. Communication in this regard will be given to user in the form of sms in local language or IVR.

5. RESULT AND DISCUSSION

The existing systems discussed need human intervention and they are also a program driven system. System that will be developed is a self learning system which will overcome all the limitation of programmed systems and it will be a truly dynamic system. Dr Santosh Bothe etc [1] has developed a self learning architecture of the human intelligence. The models developed take into accounting parameters, system and subsystems involved in the process of decision making. With models he has proved that knowledge building is ongoing process. It keeps continuously updating the knowledge base and learning and training. The same type of mathematical models can be applied to the proposed system. The system is capable to evolve with time and learn on its own. If given a sufficient learning time and training it can prove a most reliable system in near future. It will also address the challenges for implementing a system with its preexisting knowledge base like affordability, usability, delivery in the form that is immediate use to the user.

6. CONCLUSION

Excessive use of pesticides results in health problems from temporary to acute effects like irritation of eyes, cancer, reproductive and developmental disorders. A self learning system will provide farmers a right type, right amount and right time use of fertilizers and pesticides through widely available resource i.e. mobile phone in their local language. The system can identify the problem in more efficient way and facilitates knowledge sharing. It is fully automated system which will definitely increase production, quality and decrease the cost of product.

7. REFERENCES

[1] Santosh Bothe, Giovanni Saggio "Self Learning Approach in Software Design" March 27th - 30th, 2011 Orlando, Florid "The 2nd International Multi-Conference on Complexity, Informatics and Cybernetics: IMCIC 2011"

[2] Sustainable agriculture, A pathway out of poverty for India's rural poor, Sustainable agriculture information network.

[3] Crowe, A., & Mutch, J. (1994). An expert systems approach for assessing the potential for pesticide contamination of ground water. Ground Water, 32(1), 487–498.

[4] 'A train ride to cancer care', Nandita Sengupta, TNN Aug 16, 2011, 06.34am IST

[5] 'Slow Poisoning of India' a documentary of Ramesh Menon.

[6] Mohammad Ei –Helly, Ahmed Rafea, Salwa Ei – Gamal And Reda Abd Ei Whab[2004] Integrating Diagnostic Expert System With Image Processing Via Loosely Coupled Technique, Central Laboratory for Agricultural Expert System(CLAES)

[7] 'JAPIEST: An integral intelligent system for the diagnosis and control of tomatoes diseases and pests in hydrophonic green house', V. Lo´pez-Morales a,*, O. Lo´pez-Ortega a, J. Ramos-Ferna´ndez b, L.B. Mun˜oz, ScienceDirect, Expert systems with applications 35(2008) 1506-1512.

[8] 'Developing an Expert System for Plant Disease Diagnosis',S.S. AbuNaser, K.A. Kashkash, M Fayyad, Journal of Artificial Intelligence 1 (2):78-85,2008, IISN 1994-5450

[9] Kheti: mobile multimedia in an agricultural co-operative', Andy Dearden, P Matthews, H Rizvi Personal and Ubiquitous Computing (2010),Volume: 15, Issue: 6, Publisher: S pringer London, Pages: 597-607

[10] 'aAqua: A database-backended multilingual, multimedia community forum',Ramamritham Krithi, Bahuman Anil and Duttagupta Subhasri, (2004), ACM Conference Proceedings.

[11] http://www.tcs.com/resources/brochures/Pages/TCS_ mKrishi-Mobile_Agro_Advisory_System.aspx

[12] Web based Expert System for Diagnosis of Micro Nutrients' Deficiencies in Crops S.S.Patil, B.V.Dhandra, U.B.Angadi, A.G.Shankar, and Neena Joshi, Proceedings of the World Congress on Engineering and Computer Science 2009 Vol I WCECS 2009, October 20-22, 2009, San Francisco, USA

[13] Muhammad Jamil Khan, Muhammad Sharif Zia and Muhammad Qasim, Use of Pesticides and Their Role in Environmental Pollution, World Academy of Science, Engineering and Technology 72, 2010.

[14] Y Yassi,A, Kjellstrom. T, Kok.T.K., Gudotli.T.L. Basic Environmental Health, World Health Organozation. Oxford University Press. 2001.

[15] Snap Judgement:Mixed Bag, The Times of India, dt 15th March 2012, Pg 16.