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Roles and Importance of E- Agriculture In Information and Communication Technology

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Abstract

Agricultural efficiency is something on which a country's economy depends majorly. Thus it is a good reason that disease detection in plants plays a vital role in farms. Various challenges such as water shortage, soil erosion, climate changes and declining fertility of the fields due to human advancement. Information and Communication Technologyin agriculture has the power to increase the efficiency and sustainability by information sharing. This paper seeks to show the contribution of Information and Communication Technology to foodsecurityandbettercropfertilityindevelopingcountries.Thepaperaimstodevelopacost-effective and user friendly solution to increase the exposure of the farmers to important information (pricing, weather conditions, food security and productivity). The paper also shows the latest trends in the Information and Communication Technology, tools and the development of an efficient frameworktocatertheaforementioneddesiresandpropertiestoimprovetheagriculturalyield.

Keywords: ICT, framework, agriculture yield, food security, weather conditions

1. Introduction

Agriculture is the largest livelihood provider in India with over 70% of its population depending directly or indirectly. Today, India ranks second in terms of agricultural output yet over 50% of farmers live in debt. Poor infrastructure and lack of relevant information contributes greatly to this. Low incomes and stress are forcing the farmers to leave their traditional occupation. In this scenario, can ICT remove the farmer's stress and elevate the Indian agriculture? Mahatma Gandhi in 1910 wrote, Farmer is the father of the nation, which was a powerful statement for the Indian agriculturesupport.Postindependence,itwastheagriculturesectorsupportingIndiaand it's struggles in earth's development. Since then, technology has played a key role. In the late 19th century, biotechnology leads the transformation that came to be known as thegreenrevolution.Itmadefoodsecuritystatusthestrongestintheindianhistory.Now it is the 21st century that hopes to do the same for the Indian farmers. From sowing and nurturing the fields and to ensure that the farmers gets the fair price, the farmers must make many key decisions throughout the farming seasonlike,

- Choosing the fertilizers andpesticides
- Weatheranticipation
- Cropdiseases

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- Seasonal infestations
- Soil nutrientsstatus

For decades, Indian farmers have dependent on the traditional methods of gathering this information and sharing knowledge but in digital India surely there is a way for informationgaptobe bridgedinaneasier,fasterandmorereliablemanner.Todayisthe fact that there exists a digital divide because of which the ICT has not been reached the rural agricultural communities in India leading to the misconceptions that the ICTs are only meant for the urban or the developed economies. ICT has created a wealth of data that can be invaluable to farmers such as satellites for weather mapping, the latest biochemicalmethodsforcropsandseeds,soilanalysisandirrigationtechniquesetcbut this information rarely reaches to the rural farmers in time [1-6]. So in order to overcome the digital divide, two things areneeded

- Compilation of all these data in a farmer friendlymedium
- A tool to connect the Indian farmer globally with all thedata

TheidealtoolforthisisthemobiledevicewhichhasbecomethefamousICTdevicetoday. In the early 21st century, the mobile technology was in its nascent stage. Smartphones and the data were not easily available at cheaper rates and even the networkconnections were the major issues in this technology. But innovations and the latest technology today not only enhance the status of farmers, but also jointly bought the farming community. These are only a few technology that enters Indian farms but there are endless possibilities [7-10].

2. RelatedWork

Today, the use of modern technologies in agriculture is growing the world. The main applications of ICTs includes the usage of GPS and GIS for correctness in farming. Smart-phonesforeducationandcropmanagement.Agricultureinthe21stcenturyfaces two majorchallenges:

- How will we feed a growing worldpopulation?
- How will we do it in a sustainable way? According to the FAO, the food production will have to increase by 70-80% by the year 2050. How is technology transforming farming?

IoT and sensors are helping the farmers to be more productive and sustainable. By puttingsensorsintheirfields,farmerscangetpreciseandrealtimeinformationontheir crops.Thesetechnologiescanincreasetheirproductivitywhilereducingtheuseofwater andpesticides.RoboticsandDronesarenotmuchbehindtoupliftagriculture.Theycan

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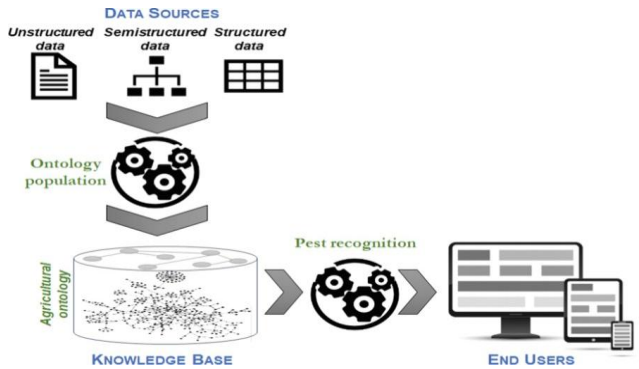
automate the farming activities such as spraying crops, weeding, planting seeds, and monitoring the plants' health. Blockchain technologies can help consumers to trace the food all the way from the crop to the plate thereby, increasing the transparency and sustainabilityoffood supplychains.Sincetheagricultureindustryhasundergonemajor developments over the last century. Robots today will accurately remove weed or shoot with a targeted spray. We might instead zap the weeds using a laser for the organic farmer. This can have a major impact.The UN reports that pests and diseases annually kill between 20-40 percent of the world's crop yield. Literature contains a large variety of image processing devices [11-13]. In [12] the author claims that all classification features for existing picture-based plant disease recognition and classification of diseases have to be assigned equal weights. Semantic technology are also being applied in agriculture [14-15]. On priority of the knowledge database, machine learningalgorithmscanbeusedtodiagnosetherelationshipscanhelptoanalyzethereal time data for crop protection [13]. In recent times, we have come across a lot of ICT applications in agriculture, education, healthcare but agriculture has n ot been given much importance. Even in the developed countries, the ICT systems are inefficiently designedandhavemanylimitations[16].Thelimitationistomaketechnologyavailable totheruralpeopleandtoconnectthemgloballyintheworldwhereagricultureisthekey factor in the growth of many economies in developing nations where agriculture holds about 45% of their GDP [1,2] . Therefore, the paper recommends a farmer friendly network generation to face the challenges of adopting ICT technologies in coming future.

3. Proposed Methodology

Theaimofthisongoingprojectistoentitletheuserswiththeinformationrequiredtotakethe preventivemeasuresandtousethepestcontroltechniquestoincreasequalitycropproductio n. Here, the data fetched from diverseframeworksis unified into a knowledge set[12]. Various expert system tools are then available to deduce this knowledge by the farmers. The model is shown in figure 1. In brief, the model works as follows. Different ontology populationprocessesareusedtofetchthedatafromdifferentsourcesincludingthestructure d, semi-structured and unstructured data. Various tools rely on the datasets to (i) analyze the dataset and understand the requirements, and (ii) To identify and classify the diseases in the crop and suggest the possible remedies.

Figure 1. Functional architecture



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Since many reasons apart from the physiological and meteorological conditions can cause diseases and pests making it difficult to analyze the data and to infer some knowledge from it. So, In order to assess the connection of the variables in the system with the conditions under which the plagues exist, machine learning algorithms shall be used. This investigation of the real time data obtained from crop monitoring can be used as the required remedial ministrations. In order to increase the corrective-ness in identifying the diseases attacking the plants, the report generated by all the three subsets will be united (through NLTextP and image processing techniques). The accuracy of the systems will also be improved overtime by getting valuable feedback from theusers.

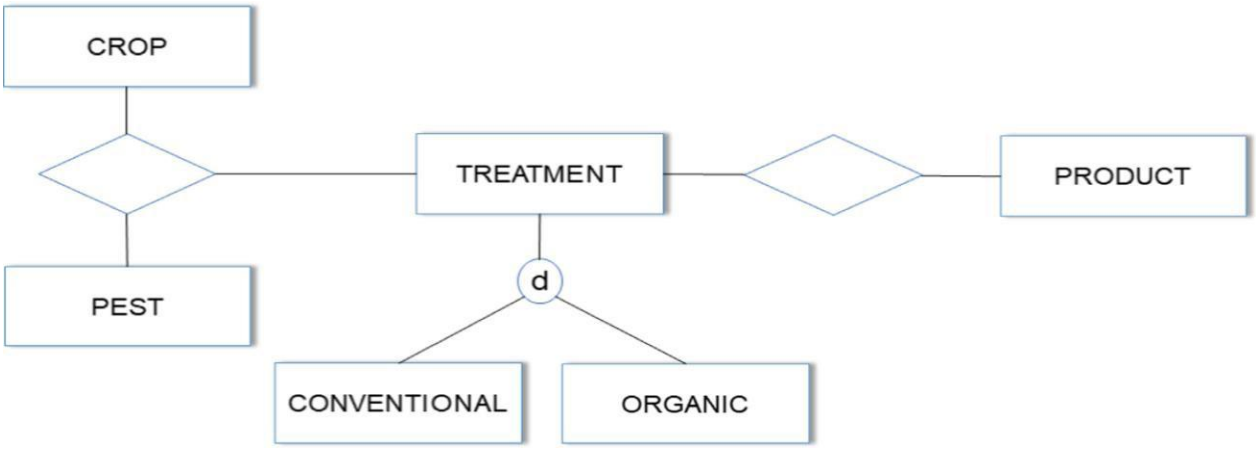

Figure 2. Database Schema

4. Results and Discussion

In order to help the agriculture sector, we suggested designing an interface capable of identifying photographs of crop diseases and recommending the most appropriate solution.ThismodelappreliesonRDBMSinsteadofdeployinganontology-based knowledge system.
Consider 'X' be the set of all agriculture services. 'Y' and 'Z' be the Agricultural Ministry of the Government.
Then 'O' could be defined as,

$$O = MAX\{\sum_{i=1}^{m} Xi + \sum^{m}{}_{j=1} Yj + \sum^{m}{}_{k=1} Zk \quad \text{(i)}$$

Subject to

$$X,Y,Z >= 0 \quad \text{(ii)}$$

This equation can be proved for best fit as shown in [16] by either analytical or simulation approach. Here is also the software implementation for the research project done, showing the functionality of the android application.

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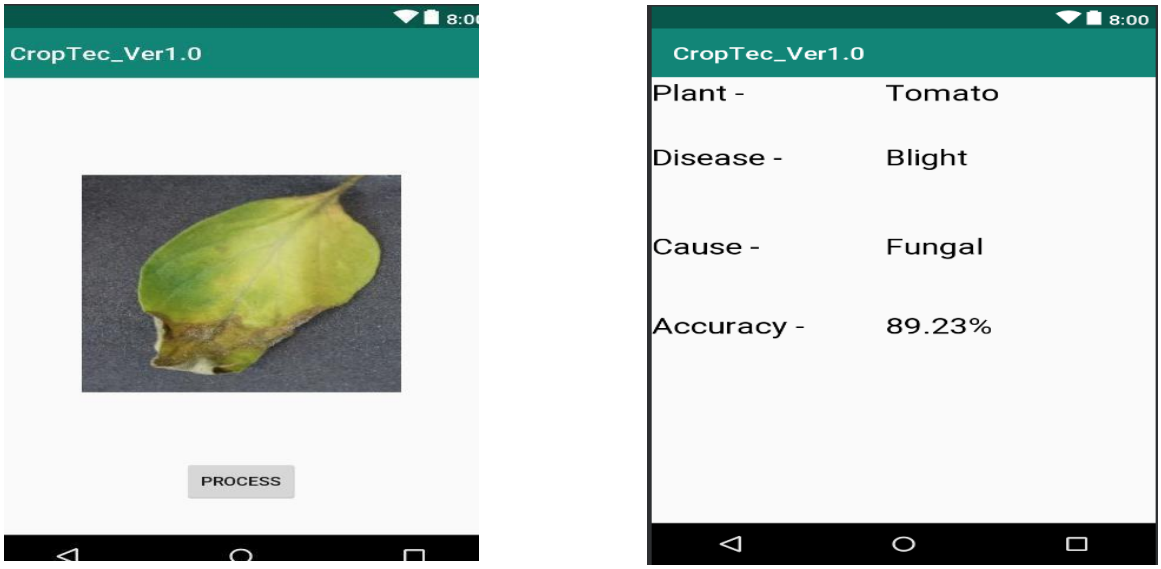

Figure 3. User interface and functionality of the Android app

The app is accessible from any android device, gets the name of the crop as input (usually a picture uploaded by the farmer) and provides the necessary information and remedy for the infected pest or disease [right]. For this, Alexnet TF and Java is used.

Table 1. Classification results as per proposed method.

Crop Disease	Bacterial Leaf	Sunburn	Fungal Disease
Bacterial leaf spot	23	0	0
Sunburn Disease	0	25	0
Fungal Disease	0	0	25
Average			**97.30**

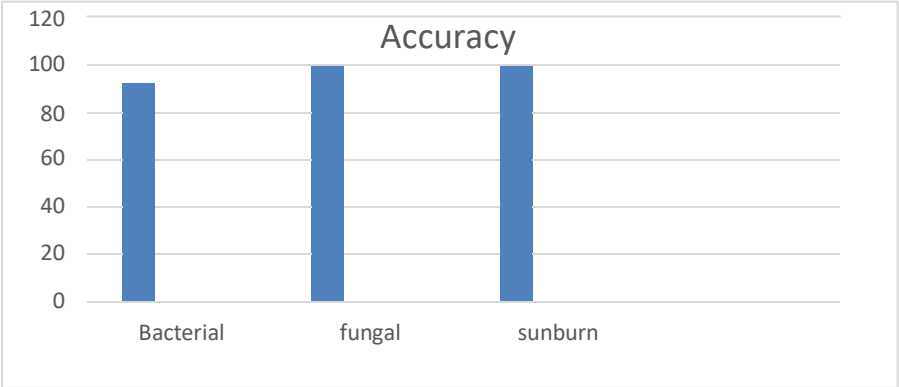

Figure 4. Classification results per class for the proposed method

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5. Conclusions and FutureScope

Innovation and Technology is revolutionizing agriculture and by the year 2050, it is expected that the population on earth will be 10 billion. Even in the 21st century, India lives in its farmlands.Butthatdoesnotnecessarilymeansthattheyarelesscapableofan ICTrevolution. The paper focuses primarily on the crop disease detection and classification. With less efforts, best results were attained, which also displays the proficiency of the above suggested methods.Thusdiseasescanbe identifiedaccuratelymuchbeforetoavoidcroplossordamage. Further improvements can be done by using Deep Learning models, IoT, Fuzzy logics and Neural Networks and much more advanced techniques.

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