International Journal of Agriculture Innovations and Research
Volume 4, Issue 2, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 26/09/2015 | Accepted on : 03/10/2015 | Published : 10/10/2015

Design and Implementation of Framework for Agri-Cloud

Dr. Suvarna Nandyal
Prof. and HOD, Department of Computer Science and Engineering,
Poojya Doddappa Appa College of Engineering,
Gulbarga, Karnataka, India

Priyanka B. Kolhapure
Department of Computer Science and Engineering,
Poojya Doddappa Appa College of Engineering,
Gulbarga, Karnataka, India

***Abstract* – India being an Agro-based economy, farmers experiences a lot of problem in crop cultivation, knowing the market status of their crop production and the crop diseases. So there is a necessity in providing all the information regarding the crop cultivation and having a proper cultivation management system in easily accessible way on a single web portal to the common farmers. The proposed work deals with the development of an AGRI-CLOUD model, which provides a web based system for the agriculture sector in India. The work carried out shows an AGRI-CLOUD model which provides assistance to the farmers in analyzing crop diseases, getting required suggestions and finding appropriate fertilizers during cultivation at minimum cost from experts at research stations or from Government officials in Agriculture departments.**

***Keywords* – Agriculture Field, Agri-Cloud, Cloud Computing, Image Processing.**

I. INTRODUCTION

Agriculture plays major role directly or indirectly in improving economy of developing countries like India, China, Brazil, Japan etc. In the current era of liberlization every sector is competitive including agriculture, so as to compete agricultural sector should also use Information technology to achieve maximum benefits.Indian farmers are poor in educational background and thus thus the traditional methods are dominating over the modern technologies in this dynamic environment resulting bad production rate.

Recent trends show that IOT (Internet of Things) is playing major role in agriculture digitization in countries like Japan, Israel etc. The impact of IOT has given good results and it is extending into latest technologies like cloud and grid computing. The IOT is a network of Internet enabled objects, together with web services that interact with these objects.

Recent Information technology revolution Cloud computing which has evolved by making base of ICT, Internet, Web services and other existing technologies. As we know IOT is also part of it we can use this along with new Computing paradigm to the agriculture sector to improve quality and to achieve better crop results by using information precisely.

II. LITERATURE SURVEY

In India, Information and Communication technology (ICT) is being used vastly as a tool in almost every sector like education, health, media, etc. But if we talk about Indian agriculture, ICT is still to be exploited for its benefits. Hence a cloud deployment model "Agri-assistant", was proposed which provided agriculture related information assistance to Indian farmers living in rural areas, facing financial and connectivity constraints. [7]. Farm management system that takes advantage of the new characteristics that ''Future Internet'' offers come in terms of generic software modules that can be used to build farming related specialized modules. Farmers report significant problems in using current agricultural information management systems, and particularly in transferring information between systems[7].

Precision agriculture(PA) is defined as the management of spatial and temporal variability of the fields using Information and Communication Technology (ICT). Data are collected from different sources (yield and quality, soil properties, remote sensing), stored to GIS data bases, analysed using geostatistical methods to develop management zones and decision support systems are used to assist farmers to the management. [4]

E-Agriculture is an emerging field focused on the enhancement of agricultural and rural development which involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICTs) in the rural domain, with a primary focus on agriculture. [5].

An android based mobile solution for Indian farmers would help them in their farming activities taking Indian farming in consideration[9].A system to provide the flowers, fruits and vegetables details (such as soil, fertilizer, method for harvesting, etc) to the farmer in voice form, free of cost, anytime , anywhere using Android smart phone without Internet Service was proposed in which a farmer just had to type number from the mobile keypad and desired information is available on the screen. [3]

The potential of WSN in the area of agriculture in India was explored. Aiming at the sugarcane crop, a multi-parameter monitoring system is designed based on low-power ZigBee wireless communication technology for system automation and monitoring. The drawback of system is its dependency on the GSM network[1]. The system which presents an integrated wireless sensor network (WSN) to monitor the information from agriculture systems namely temperature, humidity, pondus hydrogenii (pH) value…etc. provided a faster and more convenient platform for the client to obtain information from an array of sensor nodes that has been set-up in an agricultural system. [6].

A software solution using image processing algorithms are developed that can recognize problems in crops from images, based on colour, texture and shape to

automatically detect diseases or other conditions that might affect crops and give the fast and accurate solutions to the farmer with the help of SMS[10]. A new Fruit recognition system has been proposed, which combines three features analysis methods: color-based, shapebased and size-based.it classifies and recognizes fruit images based on obtained features values by using nearest neighbors classification. This system also serve as a useful tool in a variety fields such as educational, image retrieval and plantation science[8].

III. System Design

The proposed system consists of an AGRI-CLOUD model along with AGRI-CLOUD framework with appropriate technical aspects to provide assistance to farmers during crop cultivation to analyze soil, crop cultivation, crop diseases and to give pricing solutions during cultivation in a cheaper means through latest technologies like cloud computing to Farmers, Agriculture Experts, Government officials.

The proposed system shows the histogram and mean RGB values of the crop images uploaded by the farmers. The crop diseases information which the system gives is offline, hence a farmer needs to send the image to the Agricultural department which they will analyse through Image Processing Technique and detail reports can be sent to the farmer.

The development of this new system involves automating the entire process keeping in the view of database integration approach. It reduces complexity in managing the data related to the agriculture products, soils, fertilizers, mandi/market details. Rich user interface is provided in order to interact with application where the User Queries and Answers are maintained. Reports are generated dynamically on a periodic basis.

3.1 Agri-Cloud Framework

Agri-Cloud framework at Software-as-a-Service (SaaS) layer supports various services to Farmers to interact with cloud by using any cheaper ways or IOT to query for information and access it in no time at free of cost from free services and by paying meager amount for pay services. Agri-Cloud can use existing cloud infrastructures like networks, servers etc.

The proposed Agri-Cloud framework shown in figure3.1 is a layered architecture contains layers like

1) Agri-Data Acquisition layer(ADAL)
2) Agri-Data Processing layer(ADPL)
3) Agri-Data Storage Service layer (ADSSL)

1) Agri-Data Acquisition layer(ADAL) uses Internet which provides services to be used by Farmers or agriculture government officials to add or query data by using their applications service interfaces either through browsers, Tablet PC's or mobile devices. ADAL is deployed as SaaS in Cloud which provides various interface services.

2) Agri-Data Processing layer(ADPL) is deployed as PaaS in Agri-Cloud which contains libraries or readymade program modules to be used to build high-level agriculture based applications.Further ADPL has divided into following modules

a) Agri-Secure Data Service
b) Agri-Data Processing Service
c) Agri-Expert Service Module
d) Agri-Solution reporting Service module.

a) Agri-Secure Data Service(ASDS) contains libraries to provide authentication, integrity, secrecy for incoming data from various sources or reporting them with solutions.

b) Agri-Data Processing(ADP) service contains libraries for analyzing the agricultural data.

c) Agri-Expert Service(AES) is a expert service layer contains libraries which allows to provide solutions or decisions after processing image and query related data from consumers and generates reports sent to farmers.

d) Agri-Solution Reporting Service(ASRS) contains libraries which provide reporting service to farmers.

3]Agri-Data Storage Service layer (ADSSL) supports database infrastructure facilities to store large amounts of data which is required in agriculture sector for results to be accurate. ADSSL is deployed at IaaS level in cloud which allows data sharing and usage.

Agri-Cloud when deployed on cloud will work in layered architecture where layer below will provide services to high level layers. Farmers, Agriculture experts, Government officials etc., will interact with Agricloud by using various devices like Web browsers, Mobile devices, PDA etc., will use appropriate application interfaces available at SaaS layer in cloud. SaaS layer will be used as Data Acquisition layer to give input to Agri-Cloud system to update databases by the experts from Agricultural research stations. Farmers at Farm lands can obtain solutions through expert systems available regarding the query.

The PaaS layer in Agri-cloud contains API's to process and analyze data, provides security and authentication to data and its users and delivers expertise solutions through expert service module available. The main purpose of Agriculture cloud is to provide the solutions to farmers in rural areas for problems related to cultivation at cheaper cost or at free of cost (if funded by government).

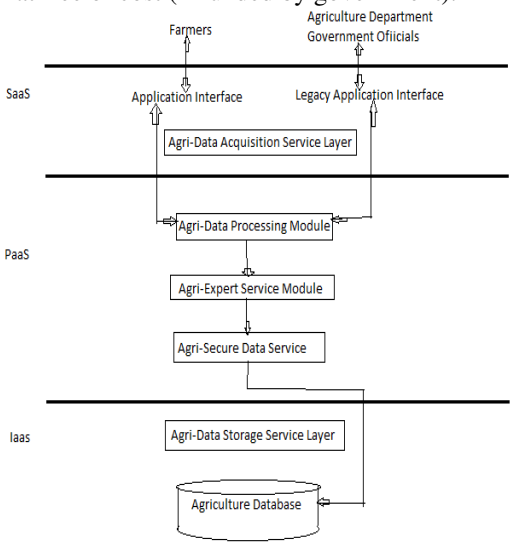

Fig.3.1. Agri-Cloud Architecture

International Journal of Agriculture Innovations and Research
Volume 4, Issue 2, ISSN (Online) 2319-1473

3.2 Sample images collected for crops

For the proposed work few samples of fruit crops are considered and the image processing is applied to them. The following section gives two examples of fruit crops along with its image and histogram values. The difference between good and bad crop is clearly seen in the histogram RGB mean values.

Here, the image of an apple having its histogram is shown in figure 3.4, where the value for red and blue mean is high which represents the good crop characteristics. The image in figure 3.5 shows another image of apple whose histogram the higher value of mean for green and blue which represents the bad crop which is infected by disease.

1) Apple

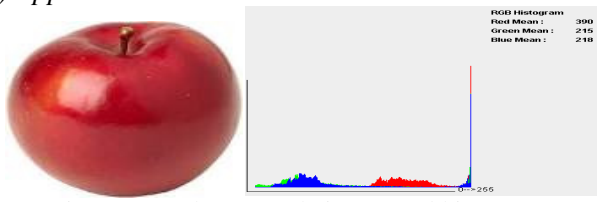

Fig.3.3. Good crop apple image and histogram

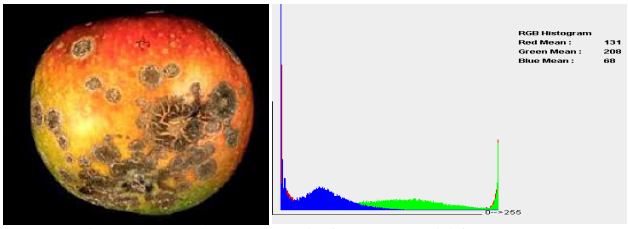

Fig.3.4. Bad crop apple image and histogram

2) Mango

Here, the image of mango having its histogram is shown in figure 3.5, where the value for red and green mean is high which represents the good crop characteristics. The image in figure 3.6 shows another image of mango with histogram which shows the raise in blue mean value compared to the normal fruit which represents the bad crop which is infected by disease.

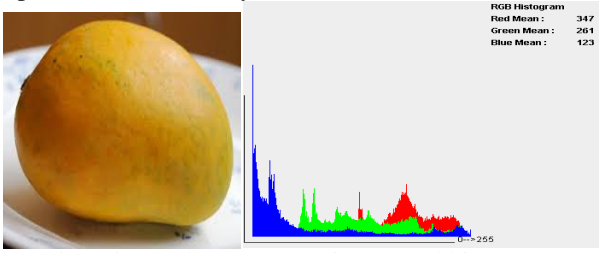

Fig.3.5. Good crop mango image and histogram

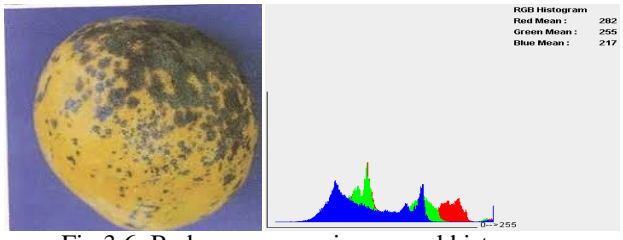

Fig.3.6. Bad crop mango image and histogram

3.3 Detection of crop diseases

The database collected for the proposed work consists of fruit crops in which some crops are diseased and some are healthy. When the farmer uploads the image of the crop, it is stored in the database and when downloaded by the agricultural officer, it undergoes image processing to get the RGB mean values of the fruit from its histogram. The RGB mean values for the good crops are stored in the system, which are compared with the RGB of the uploaded crop image. Based on this comparison the output result of whether the crop is good or bad is known. The following figure 3.2 shows the proposed methodology of detecting crop disease discussed above.

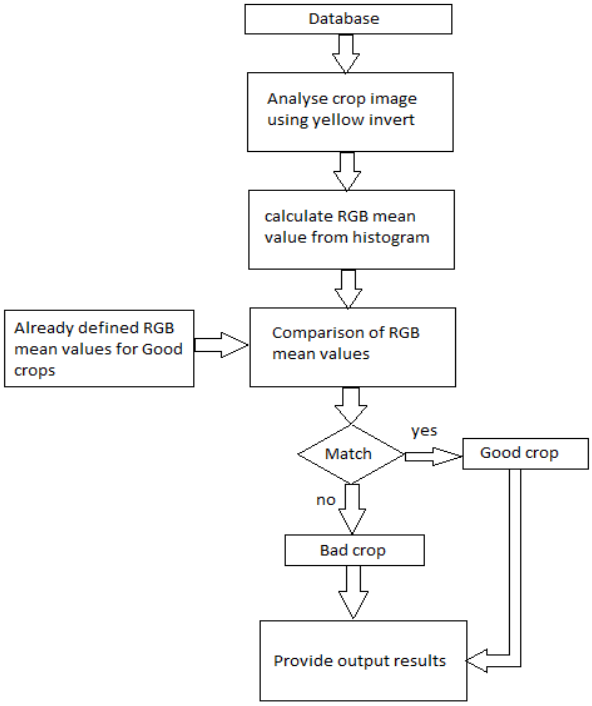

Fig.3.7 Crop disease detection using image analysis

Input RGB Colored Image :

As we know, each color is made up of combination of three primary colors- red, green and blue. To represent a color in colored image each pixel has a fixed value of red, green and blue components. In RGB color space pixel p (i) is defined by ordered triplet of red, green and blue coordinates (r(i),g(i),b(i)),which represents the intensities of red , green and blue light respectively.

Calculate Mean Values :

To classify the crop into good or bad categories, we need to obtain a range of mean value of red, green and blue layer for each crop. These ranges values are used as a reference. The mean values of red, green and blue layers are calculated using the following equations:

Mean R = R / No. of pixels
Mean G = G / No. of pixels
Mean B = B / No. of pixels
Where,
Mean R = Mean value of Red layer
Mean G = Mean value of Green layer
Mean B = Mean value of Blue layer
R = Red pixel, G = Green pixel, B = Blue pixel

International Journal of Agriculture Innovations and Research
Volume 4, Issue 2, ISSN (Online) 2319-1473

The range value (minimum and maximum) of RGB mean for each category (Good, Bad) is obtained from the above calculation. This range value is used as a reference in order to classify the category of crop.

IV. Results and Discussions

The following are the results obtained for proposed work. The Figure 4.1 represents the home page which provides us with menu showing the button options for a login, training and general information option.

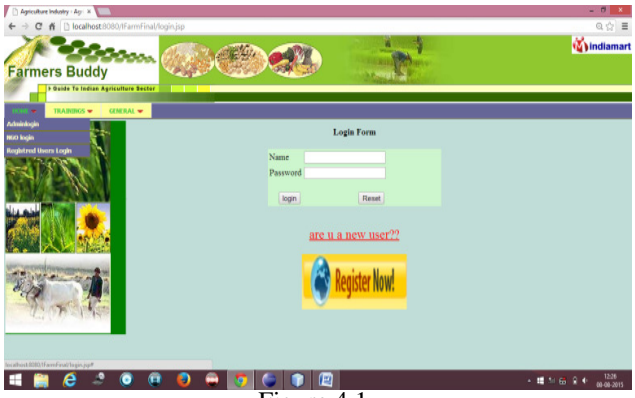

Figure 4.1

The login is provided for Registered users (farmers), Administrator and NGO. The registered farmers can access all the information about the crop cultivation, suitable soils, fertilizers and get the monthly market reports of crops.

The following figure 4.2 represents a table on client side which shows the monthly market reports provided for farmers.

Crop name	Model	Model price (Rs/Kg)	Units of arrival (Kg)	Market area	Unit price (Rs/Kg)	Grade	Market name	Variety	Maximum price (Rs/Kg)	Arrival date
Mango	101	200	100	Jewargi	150	A	Supermarket	Two	250	23/05/2015

Figure 4.2

Along with the queries the farmer can also give the information regarding the crop cultivated in their field and what symptoms are being noticed and in which place as shown in Figure 4.3, by uploading an image of the crop as shown in Figure 4.4, which can help administrator to make proper analyses for crop disease based on the histogram and RGB mean values generated by the system.

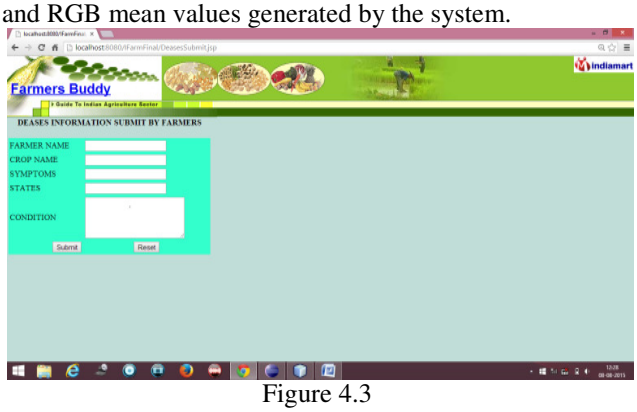

Figure 4.3

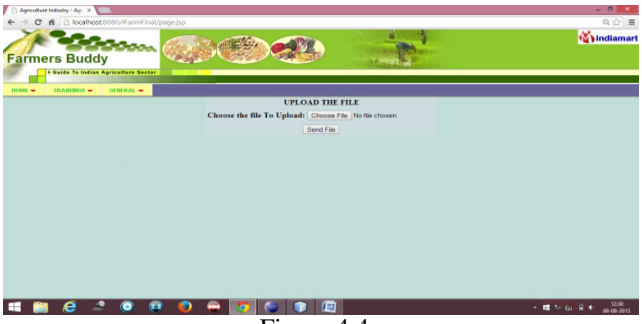

Figure 4.4

All the disease information are provided to farmers as shown below in Figure 4.5 which represents a table providing solutions for various diseases to farmers by the Admin.

Solution ID	Crop name	Type of crop	Symptom	Disease name	Solution
1	Mango	Fruit crop	Dark spots on fruits	Anthracnose	Before storage treat with hot water, (50-55 degrees) for 15 minutes.
2	Apple	Fruit crop	Fruits show small, rough, black circular lesions	Scab	Clean cultivation, collection and destruction of fallen leaves

Figure 4.5

Apart from diseases, the farmer can post any queries regarding the cultivation to either the administrator or the NGO. The admin has the rights of manipulating the data about crops and managing the farmer problems. The admin can add the database for new crops for particular region and season, fertilizer details ,and generate market reports for specific months as shown in Figure 4.6.

Figure 4.6

The uploaded image of the crop can be downloaded by the admin as shown in Figure 4.7, and carry out offline analysis of the image by getting the yellow invert of the image, its histogram and also the RGB mean values as shown in following Figure4.8.

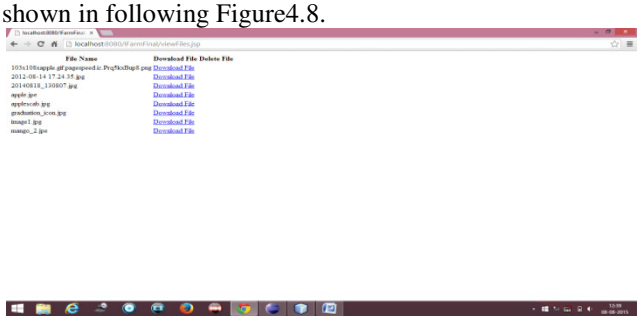

Figure 4.7

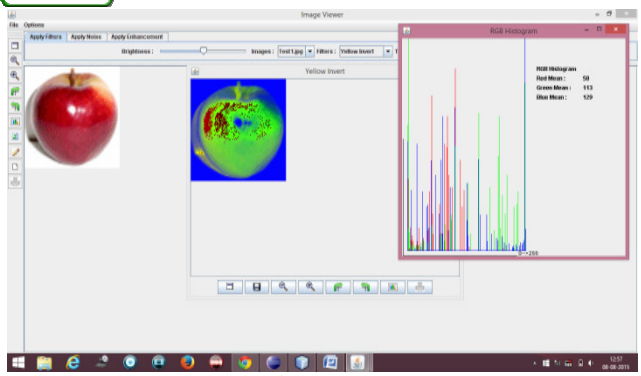

Figure 4.8

The work provides an application to the admin to get the image RGB mean and histogram values to get a clear view about the crops. Based on the analysis the admin provides appropriate solution to farmers as shown below in Figure 4.9.

Disease ID	Farmer name	Crop name	Symptoms	State	Condition	Reply status
1	Rohitk	Mango	Dark spots on fruits	Maharashtra	Temperature is around 38 degrees and soil type is black	REPLY
2	Anil	Apple	Fruits show small, rough, black circular lesions	Karnataka	Temperature is around 30 degrees	REPLY

Figure 4.9

The NGO can provide the trainings for farmers which are either organized by government or requested by the farmers. The scheduled status of trainings are also displayed to farmers.

V. Conclusion and Future Scope

The proposed work provides an Agri-Cloud model along with Agri-Cloud framework with appropriate technical aspects to provide assistance to farmers during crop cultivation to analyze crop cultivation, crop diseases and to give pricing solutions during cultivation in a cheaper means through latest technologies like cloud computing to Farmers, Agriculture Experts, Government officials. The proposed system helps farmers especially the Indian farmers to assist them in agricultural needs as well as in education, crop analysis and understanding it more clearly. An application of cloud computing is more suitable for agriculture as large agriculture data is to be processed and stored at cheaper prices which is essential in developing countries at this juncture.

As a future work, we can improve the Agri-Cloud architecture by introducing many more algorithms for crop analysis of both leafy and non-leafy crops and reduce the distance between the farmers and the government. In addition a mobile app can be developed so as to extend the use of this application for use in android devices making it available in playstore.

References

[1] Alexandros Kaloxylos, Robert Eigenmann, et.al., 2012 "Farm management systems and the Future Internet era" Computers and Electronics in Agriculture 89 130–144

[2] Anjum Awasthi, S.R.N Reddy ,IP University, India, Year 2013 "Monitoring for Precision Agriculture using Wireless Sensor Network-A Review" Global Journal of Computer Science and Technology Network, Web & Security Volume 13 Issue 7 Version 1.0

[3] D. G. Chandra and D. B. Malaya, 2011. "Role of eAgriculture in Rural Development in Indian Context ", Emerging Trends in Networks and Computer Communications (ETNCC), IEEE, DOI: 10.1109/ETNCC.2011. 6255913

[4] Krishi Ville, Singhal, M. 2011 "Android based solution for Indian agriculture", ABV-Indian Inst. of Inf. Technol. & Manage., Gwalior, India

[5] Pramod S. landge, Sushil A. Patil ,July 2013 " Automatic Detection and Classification of Plant Disease through Image Processing" Volume 3, Issue 7, ISSN: 2277 128X ,International Journal of Advanced Research in Computer Science and Software Engineering

[6] Theofanis A. Gemtos, et.al., September 2011 "Precision Agriculture Applications in Horticultural Crops in Greece and Worldwide" Proceedings of International Conference on Informtaion and Communication Technologies for Sustainable Agri-production and Environment (HAICTA 2011), Akiathos, 8-11

[7] Tuli A, Hasteer N, Sharma M, Bansal A, 2014 "Framework to leverage cloud for the modernization of the Indian agriculture system", Amity University, Uttar Pradesh, Noida, India, ,

[8] Vimal B. Patel, Rahul G. Thakkar, Bankim L.Radadiya February 2014 "An Android Application for Farmers to Disseminate Horticulture Information"; International Journal of Computer Applications (0975 – 8887) Volume 88 – No.4,

[9] Woo Chaw Seng, Seyed Hadi Mirisaee "A New Method for Fruits Recognition System" , Faculty of Information Science & Technology University kebangsaan Malaysia

[10] Wen-Yaw Chung , Pei-Shan Yu , Chao-Jen Huang "Cloud Computing System Based on Wireless Sensor Network" Proceedings of the 2013 Federated Conference on Computer Science and Information Systems pp. 877–880

Author's Profile

Dr. Suvarna Nandyal
is presently working as Professor and is HOD in Department of Computer Science and Engineering, Poojya Doddappa Appa College of Engineering, Gulbarga, Karnataka, India. She received her B.E Degree in Computer Science and Engineering from Gulbarga University, Gulbarga 1993, M.Tech Degree in Computer Science and Engineering from VTU Belgaum in 2003 and Ph.D. Degree in Computer Science and Engineering from Jawaharlal technological University, Hyderabad, AndraPradesh, India in 2013. She has teaching experience of 20 years. She has extensive research interests in Image Processing, Video Processing, Speech Recognition, Cloud computing and Information retrieval. She is member of ISTE and IETE. She has published number of research papers in International and National journals and conferences. She is involved in various academic activities such as curriculum development and professional society activities. She has guided post graduate students and two Ph.D scholars are working under her guidance.

Priyanka B. Kolhapure
received the B.E degree in 2013 and pursuing M.Tech(2013-2015) in Computer Science and Engineering from Poojya Doddappa Appa College of Engineering, Gulbarga, Karnataka, India. Cloud computing is the field of interest.