

Modelling an Efficient Cloud-based System Approach for Agricultural System

Dr. P. Sherubha¹, Mrs.L.Nivetha², Dr.J.Yogapriya³ and Dr. P. Preethi⁴

¹Assistant Professor, Department of Information Technology, Karpagam college of Engineering
Email: Sherubha0106@gmail.com

^{2,4}Assistant Professor, Department of Computer Science and Engineering, Kongunadu College of Engineering and Technology
Email: Nivetharaj59@gmail.com, preethi1.infotech@gmail.com

³Professor & Dean (R&D), Department of Computer Science and Engineering, Kongunadu College of Engineering and Technology
Email: Yogapriya.j@gmail.com

Abstract—Agricultural field modernization is one amongst the major confronting crisis in India. At present, farmers are undergoing numerous crisis in agricultural fields like market infrastructure, deficiency in irrigation infrastructure and transportation infra-structure in the presence of middle-men chain via where most agricultural commodities may circulate more prior before reaching customers. One probable solution for enhancement is utilization of mobile applications that assist in attaining information from farmers like environmental and location based information. This work explains in detail about providing a solution with classification model using machine learning algorithms integrated with mobile based cloud computing. This makes farmers to work more smartly and improves productivity. This modelling enhances superior development in agricultural modernization, provides smarter agriculture and effectual way to resolve problems relating to farmers, agriculture and so on. Simulation was carried out in MATLAB environment; the anticipated model shows better trade of in contrary to existing approaches.

Index Terms— Modernization, agriculture, crop cultivation, classification, machine learning, cloud computing.

I. INTRODUCTION

Agriculture is measured as a most essential backbone sector in India with roughly about 70% of Indian population resides over rural areas and may earn for live hood with agriculture and allied income [1]. This field consumes drastic complexities by upgrading technologies in circumstances with reduction in proper resources need for next generation [2]. This field may possess features such as complexity, spatiality, dynamics, enormousness and various parameters that influences quality and production and more as it is complex for every crop [3]. Indian farmland environment is drastically confused with nature and comprises enormous amount of environment elements to human, environment to financial, society based topology and so on [4]. Approaches for gathering data generally involve technologies and substantial costs. Raising demands for agricultural products, moreover, influences chances for farmers to maintain and enhance occupation [5]. However, owing to extensive gap among what technologist attains in experimental land and what farmers attain with farming are complex and

it produces extensive gap among 'best practices' and general way for farmers [6]. Information and communication technologies (ICT) is measured as a key element in providing various complexities and improving factors of country agriculturalists [7]. It provides chances to offer newer exercises, applications and newer administrators to rustic fields to improve prevailing management.

The functionality of IT is to progress agricultural research, education and massiveness to enhance existence quality in rural region as established in India [8]. It may assist average Indian farmers to acquire appropriate information relating to crop production, agro-inputs, marketing support, agro-processing, farm agri-business management and agro-financing. At present, Indian farmers are concentrating towards narrowing of extensive revenue expenses with numerous resources of information such as fuel and composts that are enlarged, meanwhile item costs seems to be remain constantly steady or it may drop [9]. Enlarged market de-regulation and globalization may increments weights on enormous small holder farmers in India. Therefore, to use complete influence over world-wide changes, rural item strategies, valuing, showcasing and exchanges are returned.

Mobile based infiltration has been considering faster even in remote rustic fields [10]. Various factors for speeding up of cellular phone technological selection has attained constant assumptions over potential commitments to imaginative spreading of innovative cultivation [11]. Mobile dependent technology offers lower-cost communication system that may assist in answering farmers' crisis and offer intermediately channel for assisting farmers.

Handling huge data is also considered to offer essential role in cloud computing based agriculture [12]. It may offer real time optimization, weather prediction, real-time function, intellectual irrigation, informational resources of farmers, price monitoring, proposals, decision making and logistics management over budgets and inventories [13]. The modern ICT availability may provide opportunities in agriculture to provide more informational decision owing to data [14]. Investigators have used big data to agricultural and recording weather, providing how climatic changes influences cultivation. Faster enhancements in IoT, cloud computing and big data are providing certain phenomenon termed Smarter Farming. Both farming and big data are providing newer ideas, therefore it is known that knowledge based applications implications for development and research is not extensively spread [15]. This work concentrates on classification of farming based data with Machine learning strategies integrated with cloud computing to shows superior functionality of modern computing.

The work is organized as Section II depicts related work with background knowledge, Section III explains proposed methodology, Section IV illustrates numerical discussions and section V shows conclusion with future extension.

II. RELATED WORKS

With cloud, intellectual gateway unit is significantly partitioned into three sections: video monitoring, local monitoring, and controlling agricultural competency [16]. Local monitoring is significantly based on data gathering from data which is transmitted to source gateway. As well, source for uploading data to cloud may be projected by functioning gateway models that shows redundancy in cloud. It is managed by agricultural infrastructure via programs like managing irrigation equipment to function low humidity condition [17]. Video monitoring module may functions with agricultural operation abilities and monitor growth.

Some investigators in [18] shows equipment monitoring module in various systems like sensor devices based sub-ordinates to facilitate equipment (equal to gateway devices). Sensing management component may handle sensor devices and perform functions like generate, retrieve, update and delete. Visualization and data management specifies that data attained from sensing are measured to display data and also be viewed with various charts [19]. Triggering data based action management specifies set automatic monitoring rule for sensing. For instance, when temperature moves to some extent, it may trigger certain action to manage equipment functionalities [20]. Device based remote control specifies controllable equipments; it may facilitate transmission of command via system to make it work properly [21].

Some investigators concentrate on management module of various agricultural products that significantly comprises production material management, managing product growth, knowledge base production cultivation, scalability and agricultural product traceability [22]. Production based data management significantly focuses on information, inventory records of productive materials utilized by farmer during agricultural development like purchase recording, inventory and seed utilization, pesticides, fertilizers and various other factors [23]. Items based agricultural production management significantly refers agricultural product records from disseminating to harvest of complete growth management like weeding, fertilization records and de-insectization [24].

Knowledge base of agricultural cultivation is based on agricultural production guide via production of crop management to assist agricultural producers to select appropriate pest prevention, control and sowing time [25].

III. PROPOSED METHOD

In most theoretical condition, technology is considered as knowledge application for practical utilization. However, innovation is used for enhancing human condition, indigenous habitation and entire financial exercises. Technologies may be categorized into two major factors. It provides mechanical item, for instance, hardware, devices, improved plant evaluation, agro-chemicals and improved kind of immunizations and creatures.



Fig 1: Generic crop cultivation using Mobile cloud computing

A. Knowledge-based technology

It specifies handling of technical knowledge and management skills that assist farmers to cultivate crops successfully or to generate animal products. Mobile based agricultural computation shows lower cost with timely data that assists Indian farmers to realize and evaluate market process, weather forecasting reports, trading facilities and providing credential facilities. Fig. 1 depicts illustration of mobile based cloud computing in agricultural system. Mobile computing may also diminishes transaction time, costs and travel by handling distance and facilitating more effectual time usage. With this communication process, it assists in promoting social communities and networks to provide health, employment, safety, recreation and other fields. Significant role and techniques for enhancing agricultural growth are provided in section below. One major enhancement is rise in community participation level, providing an information based decision making, significantly higher contribution from rural environment. Some examples are depicted that it may leads to farmer communities in enhancement in agricultural.

B. Disease management

Mobile base cloud computing can be utilized by farmers, for instance, taking photos of crops/yield with cellular phone and transfer it to database in which specialist may analyze harvesting development in perspective of shading and various properties. Individuals may provide own care towards stickiness and temperature to make substitution for sensing information; if nothing is applicable. Fig. 2 depicts various crop disease is transmitted via mobile from various regions.

C. General practices

Acquiring experimental knowledge of various farmers in information that makes farming aid and reliable for novel entrants to industries.

D. Environmental visualization

This comprises of sensor dependent technology to handle various aspects like temperature, humidity or CO₂ concentration and data transmission regularly over network for examining centres. Enhancement in this technology may facilitate potential utilization of environmental control.

E. Growth visualization

Data gathered from sensors dependent technology is utilized by examining centres to recognize effect that influences environmental changes that may project future harvesting and crop growth.

F. Sale and production visualization

This is significantly based on factors like timing and volume of agricultural production and also relies over marketing prices.

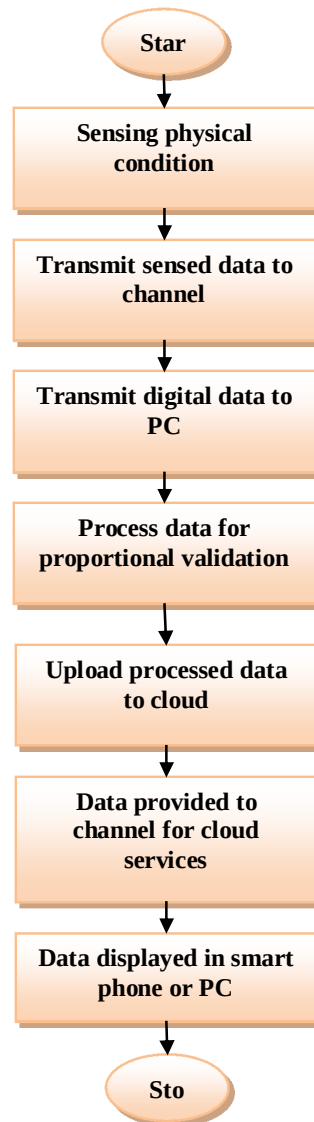


Fig 2: Flow diagram of proposed model

G. Crop production and vegetation

Mobile based cloud computing assists in management and production of agriculture with historical data provided by farmers. Following are instances provided in two significant manners:

- In poor harvesting condition, the cause of being recognized by evaluating previous information on growing nature and acquiring knowledge in future crop cultivation.
- Newer crop entrants to industries may acquire information regarding present scenario at factory farming and causes modification to environment to bring it nearer to optimal circumstances.

H. Classification

Crop classification and land coverage classification in various systems are considered to perform three essential factors and more appropriate pixel based machine learning models: ANN, SVM and RF. Every method possesses certain disadvantage and advantages. In recent times, there are enormous differences in learning procedures that may carry out pixel based modelling, however accuracy enhancement may be provided which is not effectual, whilst learning are extremely time consuming for various region. Classification can provide accuracy frequently depending on machine learning techniques, however also over in-situ data quality and appropriately chosen factors of classifiers. In-situ in various investigations is gathered from survey.

It is not probable to produce universally appropriate classification for various territory owing to various classification is raised at territorial and various kind of available satellite data. Henceforth, output and input dimension of classifier may be varied in diverse fields. Factors for machine learning model may be varied based on number of input images. Therefore, results with number of input features, percentage of available noise and number of in-situ samples are provided in training. Therefore, it is complex to recognize classification approach for every accessible data. For resolving this crisis, this work proposes a training model with three most appropriate classifiers: ANN, SVM and RF and chooses finest approach for mapping in various study field autonomously.

For selecting variables at every step for finest split, Gini index is cast of in most cases as provided in Eq. (1) and Eq. (2):

$$g(x_n) = \sum_k p_{mn}(1 - p_{mi}) \quad (1)$$

$$G(Q, \theta) = \frac{x_{left}}{N_n} H(Q_{left}(\theta)) + \frac{x_{right}}{N_n} H(Q_{right}(\theta)) \quad (2)$$

Where G is node collection based Gini index, g is single node Gini index, N_n is number of n^{th} node records, x_{left} is number of left child records, x_{right} is number of right child records, p_{mn} is fractional item labelled with 'n' class in 'n' nodeset.

In RF case, sensitive factors for accuracy are number of trees in forest and maximal decision tree depth. With SVM training process, error function is diminished with Eq. (3):

$$E(W) = C \sum_{n=1}^N \max(0, 1 - y_n(wx_n - b)) + \frac{1}{2} \|w\|_2^2 \quad (3)$$

Where w is weights, C is regularization co-efficient, x is input, y is output, b is bias.

It is considered that most sensitive factors for SVM classification accuracy is C , kernel type for gamma and non-linear cases. Most effectual kernel kinds are sigmoid with $K(x_i, x_j) = \tanh(\gamma x_i^T x_j + r)$ and Gaussian radial functionality $K(x_i, x_j) = \exp(-\gamma |x_i - x_j|)$. With training phase of neural network, common utilization of cross entropy for error computation is given as in Eq. (4):

$$E(W(h)) = \frac{1}{N} \sum_{n=1}^N \sum_{k=1}^k t_{nk} \ln(y_{nk}) + \frac{\alpha}{2N} \|w\|_2^2 \quad (4)$$

Where h is sum of hidden neurons, w is weight, N is total samples, k is total classes, α is regularization coefficient, y is classifier result and t is targeted result.

To validate efficiency of anticipated model perform this computation in agricultural field. For this reason, identify finest hyper parameters model with k -fold validation strategy that are cast off. Recital of chosen hyper-parameters is trained with evaluation of independent factors that are not used in various selection processes. Considering various developmental workflow, classification step is performed with diverse machine learning process like, ANN, SVM and RF approaches that are explained in detailed way for corresponding approaches. The essential benefits of anticipated model compared to traditional workflow are provided in various folds:

- 1) Storage capacity based flexibility
- 2) Computational resource scalability- processing big data parallel over various computational instances.

IV. NUMERICAL RESULTS AND DISCUSSIONS

This section explains in detail about MATLAB simulation environment for validation classifiers in agricultural lands. Machine learning approaches like ANN, SVM and RF are used for data processing, where these data will be stored in Mobile cloud for providing smarter farming methodology as in Table I, Table II and Table III.

TABLE I: STAGE ONE CROP CULTIVATION

Stage one				
Path	Data from every path	Number of paths		Path size/ GB
		2019	2018	
6	3	21	20	709
20	2	22	20	231
25	5	22	19	1130
64	5	23	18	1207
79	3	21	18	713
93	4	20	1	825
108	2	21	21	668
137	4	20	21	1188
166	4	21	22	1066
Total	40	200	18	331980

TABLE II: STAGE ONE CROP CULTIVATION

Stage two				
Path	Data from every path	Number of paths		Path size/ GB
		2019	2018	
29	3	57	37	1047
20	1	54	54	523
102	1	57	36	527
131	3	57	27	1062
Total	8	295	124	284102

TABLE III: STAGE ONE CROP CULTIVATION

Stage three				
Path	Data from every path	Number of paths		Path size/ GB
		2019	2018	
27	2	22	22	764
100	2	22	22	777
173	2	34	34	67
Total	6	78	78	118575

TABLE IV: CLOUD BASE DATA STORAGE

Function	Cloud functionality	Local
Downloading speed	20-35	< 6
Downloading time	~7	> 21
Pre-processing	~15	~ 1 – 3
Data filtration	~3	~ 9 – 10
Pre-processing results	1	0
Total processing time	~65	~65
Classification data	0	~7

From Table IV depicts cloud based computation for processing data while cultivating crop in farming land. Fig 3, Fig 4, Fig 5 and Fig 6 depicts classification computation in diverse Iterative factors. The anticipated model shows better computation in terms of prediction accuracy. Approaches like ANN, SVM and RF are compared to show accuracy computation in various iterations. Data related to farming land is attained from available online data sources from 2018-2019.

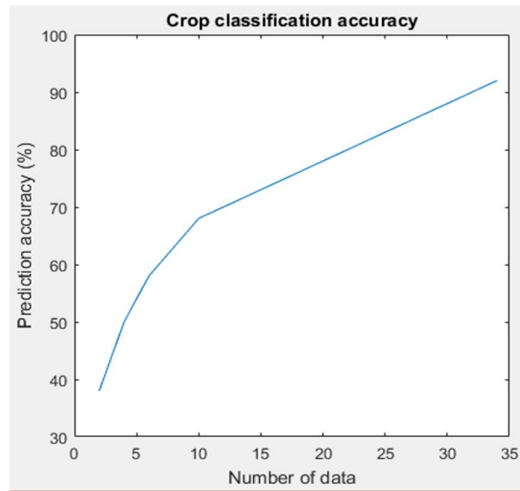


Fig 3: Prediction accuracy

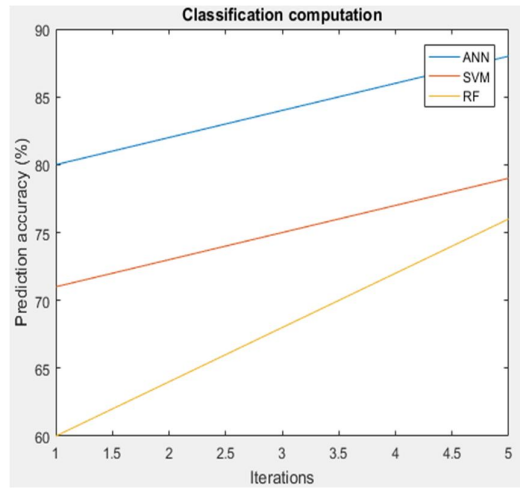


Fig 4: Classification computation

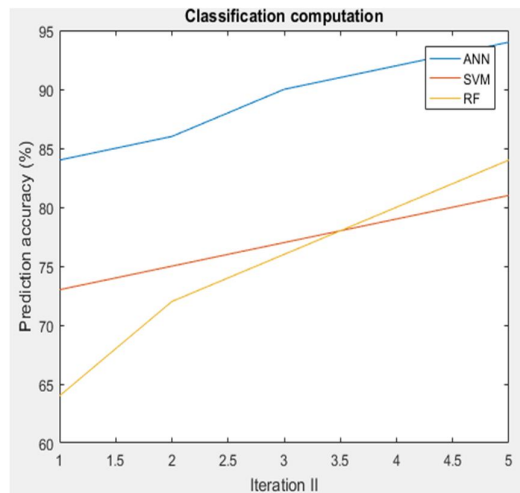


Fig 5: Classification computation in Iteration II

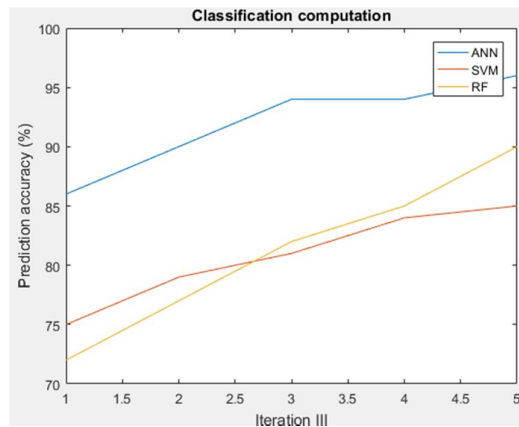


Fig 6: Classification computation in Iteration III

V. CONCLUSION

The significant benefits over cloud based modelling to handle classification of huge amount of data is for: higher speed downloading data, parallel data processing for huge region coverage over diverse instances like Amazon EC2 concurrently (parallel data processing), essential resources are needed for improved machine learning approaches and huge storage ability.

Utilization of cloud facilitates essential reduction in execution time for validating finest factors and time for acquiring classification. It facilitates training model over huge amount of training samples and optimize huge amount of factors in contrary to local computational resources.

Subsequently, it facilitates concurrent updation with temporal resolution of crop type mapping with satellite imaging time series during vegetation after every visit with standard improvement in accuracy.

To get rid of various confronts that happens in dealing these optical data over crop mapping like shadow masking and non-perfect cloud, image acquisition for diverse tiles of various data and so on. This computation is based on agricultural data. This is not for big data computation that is discussed in time serious of agricultural images for crop type mapping and crop land. As well, in future, this work may resolve various crises regarding data for huge territories may improves accuracy during classification that are mapped in contrary to mapping on agro data.

REFERENCES

- [1] Ashktorab V, Taghizadeh SR (2012) Security threats and countermeasures in cloud computing. *Int J Appl Innov Eng Manag (IJAIEM)* 1(2):234–245
- [2] Buyya R, Yeo CS, Venugopal S, Broberg J, Brandic I (2009) Cloud computing and emerging IT platforms: vision, hype, and reality for delivering computing as the 5th utility. *Fut Gener Comput Syst* (25)6. Elsevier, Amsterdam, pp 599–616
- [3] Fox GC, Kamburugamuve S, Hartman RD (2012) Architecture and measured characteristics of a cloud based internet of things. In: *International Conference in Collaboration Technologies and Systems (CTS)*, IEEE, pp 6–12
- [4] Gubbia J, Buyyab R, Marusic S, Palaniswami M (2013) Internet of things (IoT): a vision, architectural elements, and future directions. *Futur Gener Comput Syst* 29:1645–1660
- [5] Mahesh DS, Savitha S, Anvekar DK (2014) A cloud computing architecture with wireless sensor networks for agricultural applications. *Int J Comput Netw Commun Secur* 2(1):34–38
- [6] Prasad MSVKV, Kumar GJ, Naidu VVS, Nagaraju GJ (2013) Use of cloud computing in agriculture sector, a myth or reality. *Int J Eng Res Technol (IJERT)* 2(10):38–42
- [7] Tian M, Xia Q, Yuan Hao (2013) Discussion on the application of cloud computing in agricultural information management. *Res J Appl Sci Eng Technol* 5(8):2538–2544
- [8] Buyya R, Yeo CS, Venugopal S, Broberg J, Brandic I (2009) Cloud computing and emerging IT platforms: vision, hype, and reality for delivering computing as the 5th utility. *Future Gener Comput Syst* 25(6):599–616
- [9] Chen MJ, Wang J, Lu Z, Niu Y (2011) Research on agricultural information resources sharing system construction based on cloud computing. *Agric Netw Inf* 11(4)

- [10] Patel R, Patel M (2013) Application of cloud computing in agricultural development of rural India. *Int J Comput Sci Inf Technol* 4(6)
- [11] Shi, P., Yan, B.: Factors affecting rfid adoption in the agricultural product distribution industry. Empirical evidence from china. *Springerplus* 5(1), 20–29 (2016)
- [12] Carolan, M.: Publicising food: big data, precision agriculture, and co-experimental techniques of addition. *Sociol. Rural.* 57(2), 135–154 (2017)
- [13] Yan, B., Shi, S., Ye, B., et al.: Sustainable development of the fresh agricultural products supply chain through the application of rfid technology. *Inf. Technol. Manage.* 16(1), 67–78 (2015)
- [14] Nobre, G.C., Tavares, E.: Scientific literature analysis on big data and internet of things applications on circular economy: a bibliometric study. *Scientometrics* 111(1), 463–492 (2017)
- [15] Ranjan, R., Wang, L., Zomaya, A.Y., Tao, J., Jayaraman, P.P., Georgakopoulos, D.: Advances in methods and techniques for processing streaming big data in datacentre clouds. *IEEE Trans. Emerg. Top. Comput.* 4(2), 262–265 (2016)
- [16] Zhang, D., Yang, L.T., Chen, M., et al.: Real-time locating systems using active rfid for internet of things. *IEEE Syst. J.* 10(3), 1226–1235 (2017)
- [17] Kalghatgi S, Sambrekar KP (2015) Review: using cloud computing technology in agricultural development. *IJSET Int J Innov Sci Eng Technol* 2(3)
- [18] Tian M, Xia Q, Yuan H (2013) Discussion on the application of cloud computing in agricultural information management. *Res J Appl Sci Eng Technol* 5(8):2538–2544
- [19] Yesugade KD, Bathiya S (2014) Agro-sense: a cloud-enabled mobile app and efficient farming system using WSNs. *IJSRD Int J Scientific Res Dev* 2(08):2321–0613 (ISSN online)
- [20] Thakur A, Kumar M, Yadav RK (2014) Cloud computing: demand and supply in banking, healthcare and agriculture. *IOSR J Comput Eng (IOSR-JCE)* 16(3, Ver. II):96–101
- [21] Thakur A, Kumar M, Yadav RK (2014) Cloud computing: demand and supply in banking, healthcare and agriculture. *IOSR J Comput Eng (IOSR-JCE)* 16(3, Ver. II):96–101
- [22] Skakun, N. Kussul, A. Shelestov, and O. Kussul, “The use of satellite data for agriculture drought risk quantification in Ukraine, *Geomatics, Natural Hazards and Risk*, vol. 7, no. 3, pp. 901-917, 2016.
- [23] Yogapriya, J., Saravanabhavan, C., Asokan, R., Vennila, I., Preethi, P., & Nithya, B. (2018). A Study of Image Retrieval System Based on Feature Extraction, Selection, Classification and Similarity Measurements. *Journal of Medical Imaging and Health Informatics*, 8(3), 479-484.
- [24] Ramchoun, M. Idrissi, Y. Ghanou, and M. Ettaouil, “New Modeling of Multilayer Perceptron Architecture Optimization with Regularization: An Application to Pattern Classification,” *Network*, vol. 1, no. 2, pp. 1-9, 2017.
- [25] Hansen, et al., “High-resolution global maps of 21st-century forest cover change,” *Science*, vol. 342, no. 6160, pp. 850-853, 2013.