Future Weather Prediction Using Genetic Algorithm and FFT for Smart Farming

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***Abstract*—in this paper, we proposed a smart farming approach using key technologies like genetic algorithm and FFT. Farmers need to be registered through android mobile app or from the desktop, having Internet connection. Cloud storage is used to store details of farmers and weather data. Present weather conditions are obtained from the farmers location using Internet and GPS coordinates for future weather forecast. The proposed model would help farmers in planning the pre-post agriculture activities. We are also sending Weather and crop damage alerts via sms and email to the farmers.**

Keywords— android, android mobile app, cloud storage, FFT Genetic algorithm, GPS, GPS coordinates, smart farming, weather data, weather forecast.

I. INTRODUCTION

Weather forecasting is one of the most challenging problems in today's era. Weather plays significant role in agriculture. Agriculture is one of the vital sources of income in Indian economic sector. [1] People are still relying on the agriculture in ruler area. Farmers are depending on the weather, to take the decision as what work to do today and what will be the condition for next few days. [2] Uncertainty in weather condition is beyond human control. However, to become adjust to new condition or diminish the consequence of harmful weather, if a forecast of the expected weather can be had in time [3].

In smart farming approach, we collect the past few years' weather data using weather API and compare it with the current weather scenario. Apply genetic algorithm and FFT on the collected data, to do the future weather prediction. The need of future weather prediction is to improve the quality of agriculture activities. Information and communication technology plays key role in agriculture [4]. ICT delivers weather prediction information to the farmers with the help of android mobile apps[5].

Cloud storage is used to store farmer details and weather data. Cloud storage is one kind of service provided by cloud computing to store data remotely. [6] Publically available cloud storage is used over here. It also saves the required cost to setup disaster recovery and backup units. We can access data from any part of the world at any time. It increases the work efficiency and reduces the operational cost [7].

A.Problem Statement To help the farmers to improve the quality of agricultural products and services by reducing investment cost by Recommendation of best suitable crop according to current or predicted weather. Also Crop damage Alert is given from historical data so that farmers can take appropriate action. The forecast of the weather events helps for suitable planning of farm using Genetic algorithm and FFT approach.

The rest of this paper is organized in following sequence. Section II provides related work which is identical to the future weather forecast in agriculture. Section III discusses proposed architecture. Section IV is the description of Genetic algorithm and Fast Fourier Transform (FFT). Mathematical model explained in the section IV.Proposed system algorithm mentioned in the section V.In the section VII, we have assert the expected results of our proposed system And finally in section VIII we conclude our work.

II. RELATED WORK

M.R.Bendre, R.C.Thool, and V. R. Thool, in [1] introduces the framework-ICT for precision agriculture which present a scenario for the use of Information and Communication Technology (ICT) services in agricultural big data environment to collect huge data. Big data analytics in agriculture applications provide an additional insight to give advance weather decisions, improve yield productivity and avoid unnecessary cost related to harvesting, use of pesticide and fertilizers.

R.D.Grisso, M.M.Alley, P. McClellan, D. E. Brann, and S.J.Donohue,in [2]Developed a Precision farming, a comprehensive approach is used to vary crop production

management across a field. This practice requires farmers to use information, technology and decision support to increase economic returns. Although getting started in PF is fairly easy, making management decisions based on PF information can be difficult. However, agricultural consultants, county Extension agents, and Extension specialists are available to help farmers implement PF programs.

R. D. Ludena, A. Ahrary et al,in [3] provides Timely and accurate information is the modern farmer's most valuable resource. This information should include data on crop characteristics, hybrid responses, soil properties, fertility requirements, weather predictions, weed and pest populations, plant growth responses, harvest yield, postharvest processing, and marketing projections. Precision farmers must find, analyse, and use the available information at each step in the crop system.

B. Rao, P. Saluia, N. Sharma, A. Mittal, and S. Sharma, in [4] introduces Cloud computing for internet of things & sensing basedapplications The Cloud computing emerges as a new computing paradigm which aims to provide reliable, customized and QoS guaranteed dynamic computing environments for end-users. In this paper, we study the Cloud computing paradigm from various aspects, such as definitions, distinct features, and enabling technologies. This paper brings an introductional review on the Cloud computing and provide the state-of-the-art of Cloud computing technologies.

B. Venkatalakshmi and P. Devi, in [5] India is an agricultural Country and 56.6% of its population depends on agriculture. Designing a Decision Support System (DSS) for crop cultivation enables the farmers to make effective decision for higher yield. The parameters that are considered for the enhancement of a seasonal crop growth are type of soil and season, Insects-Pests management, irrigation methodologies. The main aim of the work is to develop a system that can provide information about the expected yield in each season with better accuracy. The decisions available to them currently are only a shallow guide for farmers due to them being unaware of various methodologies. Inefficiency in a farmers? decision results in the low productive rate of paddy than the expected rate. The growth of seasonal crops is decided basically by two factors, namely the soil type and the season. Also based on the crop type the farmer must adoptively use the insecticides and fertilizers. Thus the parameters to be considered are identified and the simulation is tested using a tool called "Netica". Based on the performance the DSS guides the farmers to improve the crop growth. The simulated results can be extended for real time usage in mobile application

A. McBratney, B. Whelan, T. Ancev, and J. Bouma in [6], This paper will present the broad concept of precision agriculture with several examples of precision nutrient management from several countries. There, farmers and practitioners have overcome the challenges associated with precision nutrition management and converted them into opportunities by harnessing the global information and developing local precision techniques suitable for their region, operation and resources. With increasing global population and limited or decreasing arable land available for crop production the question arises "will we be able to overcome the future challenges and seize them as opportunities?" Precision agriculture management coupled with genetic improvements in crop traits will play a crucial role in meeting global demand for food, feed, fiber and fuel in the near and distant future.

III. PROPOSED SYSTEM ARCHITECTURE

In our proposed system architecture, in order to operate this system user can be use android device or desktop with internet connection. User should be register with the system in order to log in. Once User logged on to the system the present weather parameters from user side are receives through GPS on their mobile phones or by using weather API in the case of desktop application's requested parameters are sent to the server. Server access past weather data from cloud storage. On the server side dataset is first loaded and then trained the dataset with the help of genetic algorithm and FFT for the future weather forecast. This future weather forecast send to the user, accordingly user can take better decision. [8]

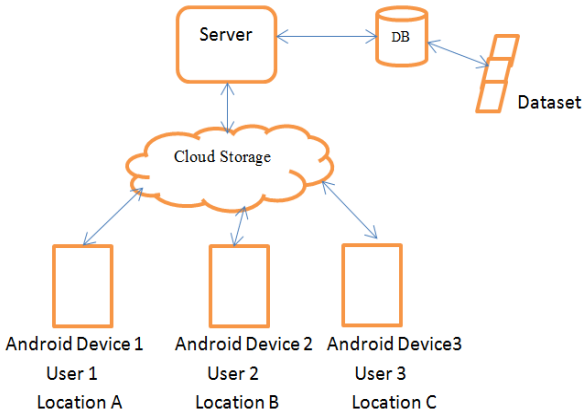

Fig.1 Architecture of proposed system

Proposed System consists of following modules:
1. Admin Module
2. Server Module
3. Android Module

1. Admin Module
In Admin module farmer's user management Actives are done.
-Register User
-User Login

2. Server Module
Server module receives Android requests. Weather forecast related dataset of previous years were stored at server. Once

the request is received Genetic algorithm will be applied and FFT will be used, in order to give better prediction result [8].

3.Android Module
Android module work as a client. All the data from farmer is collected and send to server and results are obtained using this module [8].

IV.TECHNOLOGY USED

1.Genetic Algorithm

A Genetic Algorithm (or GA) is a search technique used in computing to find true or approximate solutions to optimization and search problems. The evolution usually starts from a population of randomly generated individuals and happens in generations.

A. Basic Genetic Algorithm

· Start with a large "population" of randomly generated "attempted solutions" to a problem
· Repeatedly do the following:
-Evaluate each of the attempted solutions
-(probabilistically) keep a subset of the best solution
-Use these solutions to generate a new population
· Quit when you have a satisfactory solution (or you run out of time)[9]

To elaborate more on this below are detailed flow steps:

- Find the size of input data.
- Generate the random binary number i.e chromosome.
- Check for the fitness whether the binary is fit for the size of data.
- Compare this data with current parameter.
- Find the difference as per threshold
- According to difference value perform mutation OR crossover.
- Perform mutation when difference is less than minimum threshold and crossover when difference is greater than maximum threshold.
- When the difference is the least we obtained the parameter.

2.FFT (Fast Fourier Transform)

The FFT is a faster version of the Discrete Fourier Transform (DFT). The FFT utilizes some clever algorithms to do the same thing as the DTF, but in much less time.[10]

To elaborate more on this below are detailed flow steps:

- Give the future date as input to FFT technique.
- Find the parameters for the same date in previous year data
- Let suppose we have 5 values for temperature parameter for 5 years.
- Apply FFT on 5th year and 4th year and calculate average of outcome value and actual value for that particular year.
- Now apply FFT on 3rd year and average of 4th year and so on.

B. Extrapolation

In mathematics, extrapolation is the process of estimating, beyond the original observation range, the value of a variable on the basis of its relationship with another variable. [11]

C. Linear extrapolation

Extrapolation means creating a tangent line at the end of the known data and extending it beyond that limit. Linear extrapolation will only provide good results when used to extend the graph of an approximately linear function or not too far beyond the known data. If the two data points nearest the point to be extrapolated are and, linear extrapolation gives the function:

$$y(x*) = y_{k-1} + \frac{X^* - X_{k-1}}{x_k - X_{k-1}} (Y_k - Y_{k-1})$$

(which is identical to linear interpolation[11] if $x_{k-1} < x^* < x_k$). It is possible to include more than two points, and averaging the slope of the linear interpolant, by regression[12] like techniques, on the data points chosen to be included. This is similar to linear prediction.

V.PROPOSED SYSTEM ALGORITHM

Following is the proposed system algorithm-:

Step 1. Client Register and then login to the system
Step 2. Continuously update weather condition using android
Step 3. Load and Initialize dataset
Step 4. Train the dataset
Step 5. Cloud storage will receive user request
Step 6. Apply genetic algorithm
Step 7. Apply Fast Fourier Transform for better result
Step 8. Predict forecast using FFT

VI.MATHEMATICAL MODEL

1.Set

Let set S = {AC, SER, DB}
Where,
S be the system
AC be the Android client
SER be the server
DB be the MySQL database.

2.Mapping

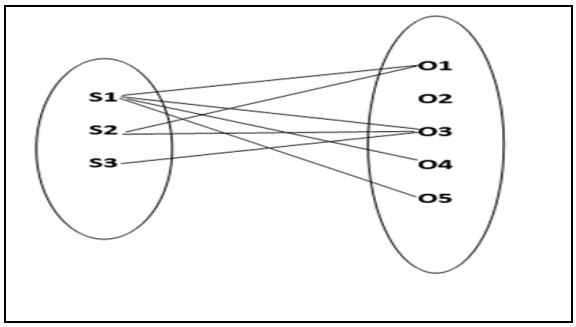

Fig.2 Mapping states and operations.

Let set S = {AC, SER, DB}
Where,
S be the system
AC be the Android client
SER be the server
DB be the MySQL database

Set of States, S = { S1; S2; S3}
Where,
S1 = User registration
S2 = Call Weather API
S3 = Predict and return Forecast

Set of Operations, O = {O1; O2; O3; O4; O5}
O1 = User Sign-up/Sign IN to the system
O2 = System recognizes current weather parameters based on GPS coordinates location
O3 = Clustered the dataset
O4 = Apply Genetic algorithm and FFT
O5 = Predict and return weather Forecast to client

3.NP- COMPLETE ANALYSIS

The proposed System is NP complete [13].
N*M
Where,
N=Number of Records
M=Number of Users

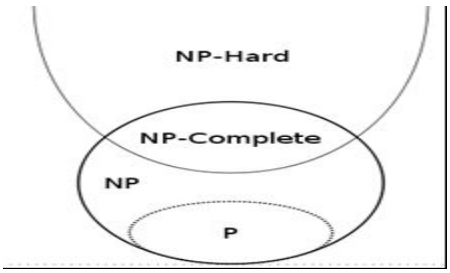

Fig.3 NP Complete analysis.

VII. EXPECTED RESULT

In this system, after applying Genetic Algorithm and FFT on the Weather data, future values of weather data are predicted. These values will assist farmers to plan their farming activities for a better yield of crops. [14]. The future predicted values of Genetic and Linear Extrapolation can be compared and a better result can be used for optimum farming [15].

Fig 3, 4, 5 and 6 shows the input data of historical temperature, humidity, moisture and wind speed. This data is used for prediction study and different color denotes the year wise data from 2010 to 2015. Fig 7,8,9 and 10 shows corresponding output predicted data.

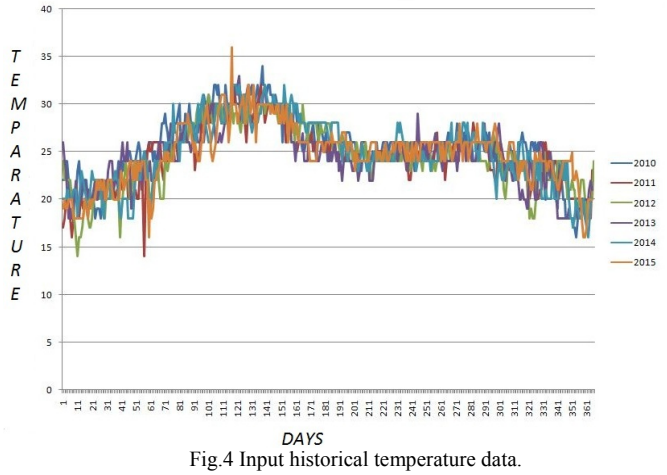

Fig.4 Input historical temperature data.

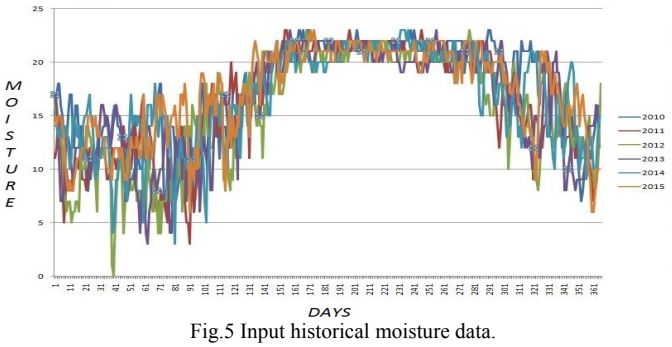

Fig.5 Input historical moisture data.

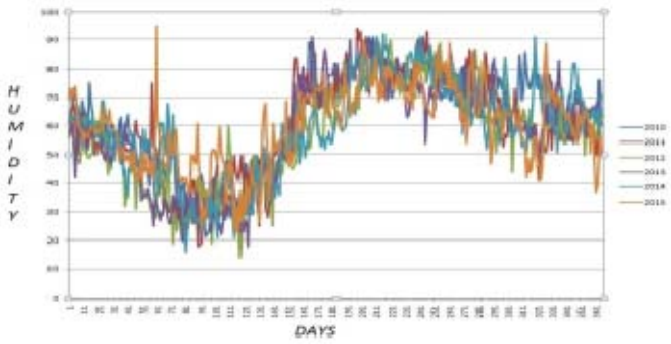

Fig.6 Input historical Humidity data.

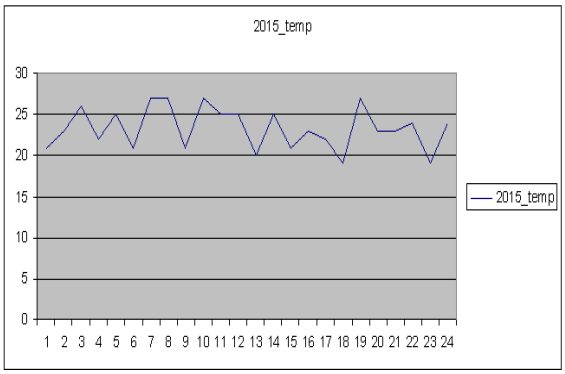

Fig.7 Output predicted temparature data.

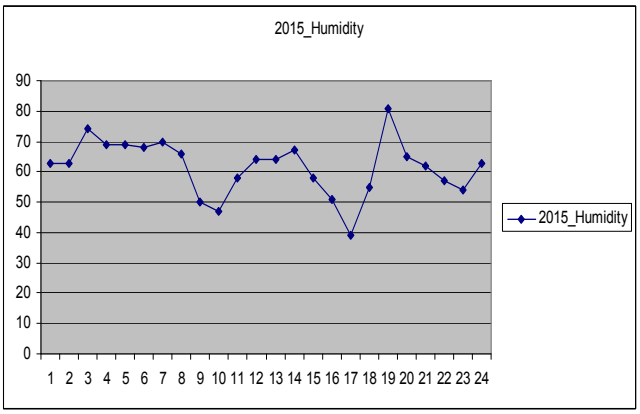

Fig.8 Output predicted humidity data.

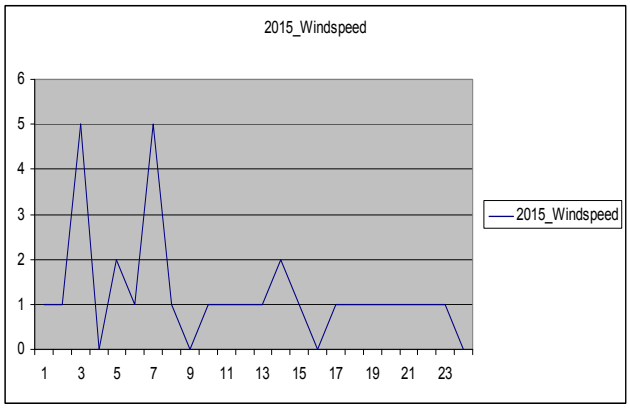

Fig.9 Output predicted wind speed data.

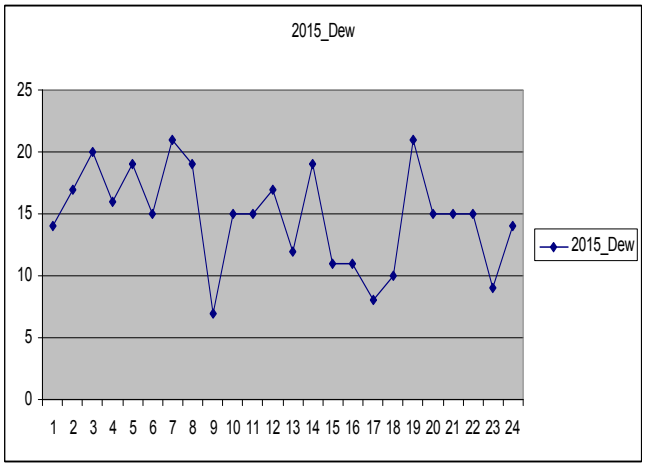

Fig.10 Output predicted dew data.

VIII. CONCLUSION

In this paper we have proposed a smart farming approach using key technologies like genetic algorithm and FFT. Farmers will be able to get future weather forecast. This is an essential requirement because all the agriculture activities depend on weather. This model will be helpful to farmers to plan pre and post agriculture activities. Also it will help in making various decisions related to crop patterns and water management. It would greatly help to improve overall productivity of agriculture.

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