

Cognitive Digital Panchayat System For Farmer Empowerment

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ABSTRACT

In this paper a machine learning-based digital panchayat web application is implemented to help people and farmers in the village to notify their problems to the Gram Panchayat. It also provides accurate crop recommendations to farmers in rural areas based on their location. Farmers in rural areas are able to receive 99.77% correct crop suggestions based on their location through developed web-based application. This in turn has increase crop productivity by 98 % and can avail the right price for their crop as decided by the government of India. Further, complaints raised by the users are resolved in a day by the respective authority. This has increased the work transparency between the village people and the administration section. In the end, the web application is validated with different test cases for Signup testing, Login testing, Complaint Section testing, and Crop Recommendation.

Keywords: DAS, LMIC, IoV, MSP

1. Introduction

India's diversity and distinctive cultural fabric have combined to present the country's government with unique challenges. The answer is Digital-governance, which provides the potential to reach India's remote villages with government services and information as never before, and as a by-product, to simplify cumbersome governmental processes. Digital governance would help the government to function efficiently and transparently. In this Digital transformation era, it is very important to focus on Digital Governance, which would help people to understand the government and present their views also government can effectively solve people's problems. It helps Indian Government to provide services and reach citizens across geographic, linguistic, and administrative lines cost-effectively. Machine learning techniques can make our villages digital and help farming as well as farmers to grow with the help of technology. A small effort could help to improve the life of the people living in the rural area and help them to improve their quality of life by making them aware of the digital transformation that has the potential to transform their life. E-Governance is a system that not only helps Government servants by reducing their unnecessary workload but also helps other people who seeking the services of the government.

To build a web application with embedded Machine Learning that could help the Gram Panchayat of the village, in efficient development of their region and help people in the village to notify their problems to the Gram Panchayat. Also to help the Farmers of the village to be well aware of technologies that can make their jobs easy. In the Existing Panchayat System Village, people should reach to Gram Panchayat office to register any complaint. The work of Gram Panchayat was less transparent. Village Farmers were not aware of the emerging technology and were not making use of the technology in farming so software requirements like programming languages and machine learning libraries databases are a must to build this application. Developers consider Python as one of the most efficient general-purpose languages. This language is simple enough to let specialists create almost anything their clients want. With the rise of big data and artificial intelligence, Python's popularity started to grow in the realm of data-related development as well. Visual Studio Code is a source-code editor made by Microsoft for Windows, Linux, and macOS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git. API is the

acronym for Application Programming Interface, which is a software intermediary that allows two applications to talk to each other. Each time you use an app like Facebook, send an instant message or check the weather on your phone, you're using an API. A database is an organized collection of structured information, or data, typically stored electronically in a computer system. The data can then be easily accessed, managed, modified, updated, controlled, and organized. Most databases use structured query lan. Further, implementation modules consisting of users and admin will help to authenticate users and add new users and involve in administrating activities. whereas, raise complaint module to inform the panchayat about the maintenance around your premises and to raise complaints regarding power loss, and water supply issues. thereafter, scheduling meetings will help the panchayat to schedule development meetings in the gram panchayat. announcement announcements regarding panchayat meetings or any instruction. crop recommendation will help farmers to know about many new methods of farming like organic farming, crops information will be provided. government schemes information will help farmers to know about the MSP of crops so that they can get an appropriate price for their crop and will also help village people to know about the government schemes available for their development.

- A web-based application to help Gram Panchayat function digitally.
- Help Farmers in the Rural area by suggesting suitable and profitable crops as per their location
- Making people aware of the government schemes that may contribute to the development of village and citizens as well
- Connecting villages digitally help citizen in villages take advantage of the technology

A useful framework for using big data in the context of tourism economic development programs is provided which proposes process framework and quality criteria provide a structured approach to collecting, processing, and analysing big data in the tourism industry. This can help tourism organizations and policymakers make more informed decisions and create more effective tourism economic development programs [1]. The valuable insights into the management of e-governance project implementation in Panchayat Institutions in India with case study is presented in the article highlights the importance of effective management strategies and stakeholder engagement in the successful implementation of e-governance projects. The article also emphasizes the potential of e-governance initiatives in transforming the functioning of local governance institutions and improving public service delivery [2]. A comprehensive analysis of the Atmanirbhar Bharat initiative and its potential to transform the Indian economy is proposed and presents valuable insights into the policy measures introduced under the initiative and their potential impact on various sectors of the Indian economy. The authors also highlight the challenges and opportunities associated with the initiative and emphasize the need for effective implementation of the policy measures [3]. A valuable survey of the different frameworks and libraries available for large-scale data mining is imparted and presents a detailed analysis of the features and capabilities of each framework and library, along with a comparison based on various criteria. The authors also highlight the emerging trends in large-scale data mining and emphasize the need for continued research and development in this area [4]. A valuable review of the digital transformation of rural governance and service delivery in India is carried out which highlights the challenges faced by rural areas in India and the role that digital technology can play in addressing these challenges. The chapter also presents case studies of digital initiatives in various sectors and emphasizes the need for effective implementation and bridging the digital divide [5]. A comprehensive review of the deployment of IoV for smart cities, including its applications, architecture, and challenges is demonstrated which highlights the potential benefits of IoV for smart cities and provide insights into the potential solutions to the challenges associated with IoV deployment. The study emphasizes the need for continued research and development in this area to realize the full potential of IoV for smart cities [6]. The details of IoT in marine environment monitoring are mentioned which highlights the potential benefits of IoT for monitoring marine environments and provide insights into the various challenges associated with IoT deployment in this context. The study emphasizes the need for continued research and development in this area to realize the full potential of IoT for marine environmental monitoring [7]. The information on the Digital Village program and its potential benefits for rural communities in India is presented which highlights the potential of the program to improve access to essential services and promote economic development in rural areas. The study emphasizes the need for continued research and development in this area to ensure the success of the Digital Village program and other digitalization initiatives in rural India [8]. The insights into the potential of technology-based village development to promote economic growth and create smart economies in rural areas are given which highlights the importance of government support and private sector involvement in these initiatives and emphasize the need for continued research in this area [9]. The current state of DAS deployment in low- and middle-income countries (LMICs) are mentioned which highlights the potential of these services to promote agricultural development and improve the livelihoods of rural communities [10]. The study also emphasizes the need for further research in this area to fully understand the impact of DAS on different stakeholders and to identify best practices for the deployment of these services in LMICs.

This paper consists of four sections. The need and usefulness of Digital Panchayat to support the Gram panchayat activities for the people in the village are discussed is explained in section 1. The background and detailed literature survey of digital Panchayat are also jotted. The implementation of the proposed system with architecture diagram, modules, and algorithms is elaborated in section 2. Further, various modules or

functions in designing an application that can assist the farmers as well as the laborers of the village are also explained. Whereas, results and evaluation of the database are presented in section 3 along with the advantages and disadvantages, and the conclusion is in section 4 followed by references.

2. Implementation of Proposed Digital Panchayat System

The only administration in the villages is Gram Panchayat. In the existing panchayat system, village people need to reach the Gram Panchayat office for registering a complaint. Further, it is found that the work of Gram Panchayat is less transparent and farmers are not aware of the emerging technology and also not making use of the technology in farming. The solution to this problem could be the use of technology and make the working of the Gram panchayat Digital. The design includes Use Case Diagram, Class Diagram, and Sequence Diagram. Hence, a web application with embedded Machine Learning is designed and developed that could help the Gram Panchayat of the village's inefficient development of their region. It also helps people in the village to notify their problems to the Gram Panchayat as shown with Class Diagram in Figure 1. It can be seen from the diagram, the classification process helps to label incoming data based on post-data samples. It is used to train the algorithm in recognizing certain types of objects and categorize them. In general, classification is categorized as binary and multiclass. Here, multiclass classification is considered to predict multiple crops to increase productivity.

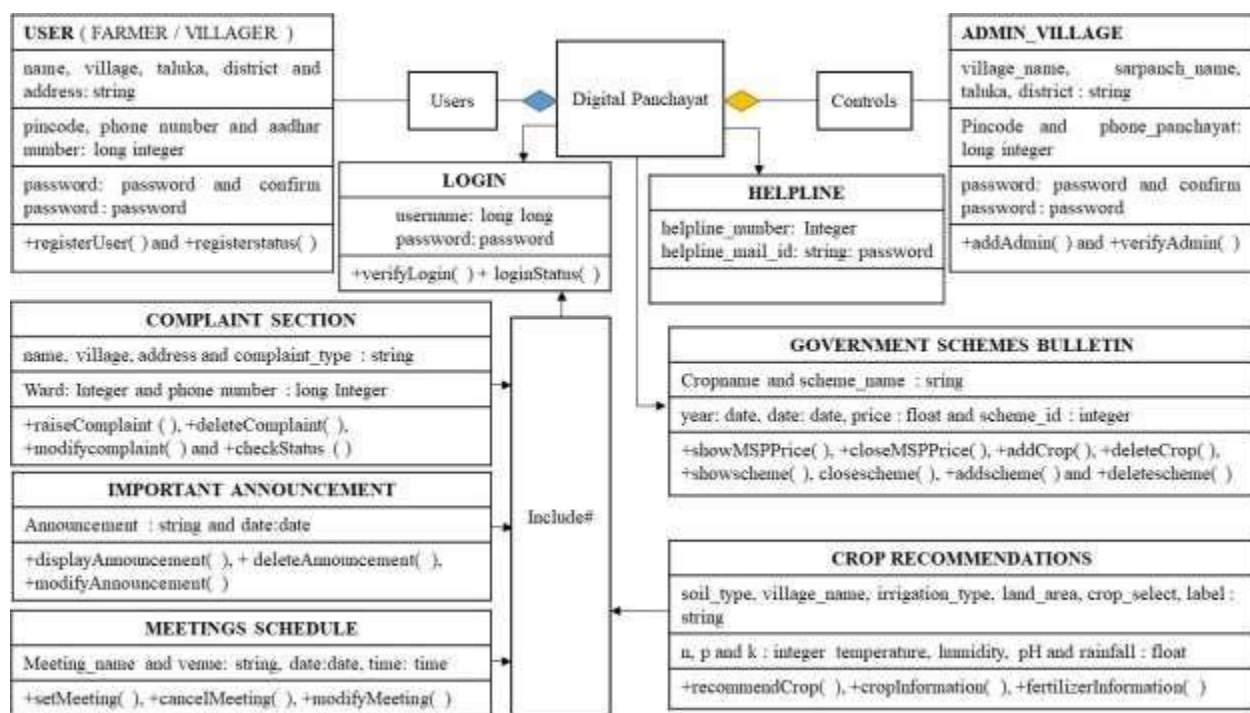


Figure 1. Class Diagram of Digital Panchayat System

A database is an organized collection of structured information or data as represented in the diagram. The data can then be easily accessed, managed, modified, updated, controlled, and organized. Further, implementation modules consist of users and admin that will help to authenticate users as well as add new users and involve them in administrating activities. Whereas, raise complaint module to inform the panchayat about the maintenance around your premises and to raise complaints regarding power loss, and water supply issues. Thereafter, scheduling meetings will help the panchayat to schedule development meetings in the gram panchayat. The crop recommendation module will help farmers to know about many new methods of farming like organic farming, crops information will be provided. The government schemes information module will help farmers to know about the MSP of crops so that they can get an appropriate price for their crop and will also help village people to know about the government schemes available for their development. The architectural Flow Diagram of the Digital Panchayat System is as shown below:-

Architectural Flow Diagram of Digital Panchayat System

1. Initialise the system
2. Generate the Home page with Panchayat Details consisting of individual Sections
 - Design Login and Sign-Up pages in all languages
 - Perform Sign Up with details such as user name, email, password, Name, Phone Street Address and Apartment Suite, City, State/Province, ZIP/Postal

Address, Country

Register by agreeing with the privacy policy and terms and conditions

3. If the Query is Complaints

then Raise a Complaint as Your complaint

Create a post for the complaint section with details such as Name, email, phone, village name and mentioning the type of complaint

5. else-if the Query is Important Announcement

then Make Announcements for Meetings Schedule

7. else-if the Query is Farmers / Crops Corner

then display MSP of various Crops and Seasonal Crop details, Suggest Fertilizers/Modern farming Technologies and provide News / Updates regarding Agriculture: MSP for various Crops in terms of Commodity, Variety, MSP for current and past in Rs. per quintal and increase over the previous year in Rs. per quintal.

10. else Display Government Schemes and New Guidelines for farmer's awareness in sanctioned budget for smart agriculture, Pradhan Mantra Awas Yojana, cooperative education, etc.

14. Crop recommendation would help the farmers to predict probability and farmers get recommendations of the crops with respective the soil analysis results in their region that would help them to grow the suitable crop as per their region with entered Nitrogen, phosphorous, Potassium, temperature, humidity, PH and rainfall value.

11. End

A sample dataset is used as shown in Table 1, first train the proposed model knowing outputs and then make predictions. Multiclass classification algorithms such as K-Nearest Neighbour, Decision Trees, and Naïve Bayes are considered in this work.

Table 1: Sample Dataset for Experimentation

N	P	K	Temperature	Humidity	Ph	Rainfall
90	42	43	20.87974371	82.00274423	6.50298	202.9355
71	54	16	22.61359953	63.6907056	5.749914	87.75953
40	72	77	17.02498456	16.988611	7.485996	88.5123143
13	60	25	17.13692774	20.59541	5.68597166	128.256862
4	59	19	26.25070298	67.62779652	7.6214945	40.8106299

Performance Metrics in terms of accuracy is a ratio between the numbers of correctly classified points to the total number of points as given by equation (1) to measure the Accuracy Score of classification algorithms as shown in Figure 2.

$$Accuracy = \frac{\text{Number of correct predictions}}{\text{Total number of predictions}} \quad (1)$$

```
models = {
    KNeighborsClassifier(): 'K Nearest Neighbour',
    DecisionTreeClassifier(): 'Decision Tree',
    GaussianNB(): 'Naive Baiyes'
}
for m in models.keys():
    m.fit(X_train,y_train)
for model,name in models.items():
    print(f"Accuracy Score for {name} is : ",model.score(X_test,y_test)*100,"%")

Accuracy Score for K Nearest Neighbour is : 97.5 %
Accuracy Score for Decision Tree is : 98.86363636363636 %
Accuracy Score for Naive Baiyes is : 99.77272727272727 %
```

Figure 2. Accuracy Score of classification algorithms

2. Results and Evaluation

Table 2 shows the validation status of various Testing conducted on the proposed system between the Test Case and Test Result. It is seen that the system authenticates users as well as adds new users and involve in administrating activities. Further, the raise complaint element can inform the panchayat about the maintenance around your premises and raise Complaints regarding power loss, and water supply issues. It also helps the panchayat to schedule development meetings in Gram Panchayat and make announcements

regarding Panchayat Meetings or any instruction. The crop recommendation helps farmers to know about many new methods of farming like organic farming and crop information. Further, it also helps farmers to know about the MSP of Crops so that they can get an appropriate price for their crop and will also help village people to know about the government schemes available for their development [31].

Table 2. Validation Status of various Testing

• **Sign-Up Testing**

S. No	Test case	Test result	Status
1	Verifying Sign Up functionality with a valid username, email, password, name, phone, address	Signed up successfully	Pass
2	Verifying sign-up without adding compulsory fields	This field is required. Please enter your email.	Pass
3	Trying to sign up after login	Already login	Pass

• **Login Testing**

S. No	Test case	Test result	Status
1	Verifying Login functionality with valid Email and Password	Login Successful	Pass
2	Verifying Login functionality with invalid Email and Password	Enter the correct username for the username	Pass
3	Trying to logging in after already logged in	Already login	Pass

• **Complaint Section Testing**

S. No	Test case	Test result	Status
1	Verifying the complaint section by adding the complaint	Complaint registered successfully	Pass
2	Verifying the complaint section not adding the complaint trying to raise a complaint	This field is required. Please enter text	Pass
3	Trying to raise a complaint without entering personal details	A name is required.	Pass

• **Crop Recommendation**

S. No	Test case	Test result	Status
1	Trying to enter text values in the fields	Text not supported	Pass
2	Verifying the working crop recommendation without entering any value	The server will not accept it	Fail

Further, Figure 3 shows the parameter relations with various crops considered for experimentation. The comparison between the proposed method and method already implemented is given in table 3. This shows that the proposed method gives more accuracy.

Advantages

1. Transparency between the panchayat and the people is increased due to online decisions made by the Panchayat. Further, complaints are raised and also solved without even going to the panchayat office.
2. Development activities are monitored online by higher authorities.

Disadvantages

1. Users can raise a fake complaint.
2. Users may not know about technology and soil analysis.

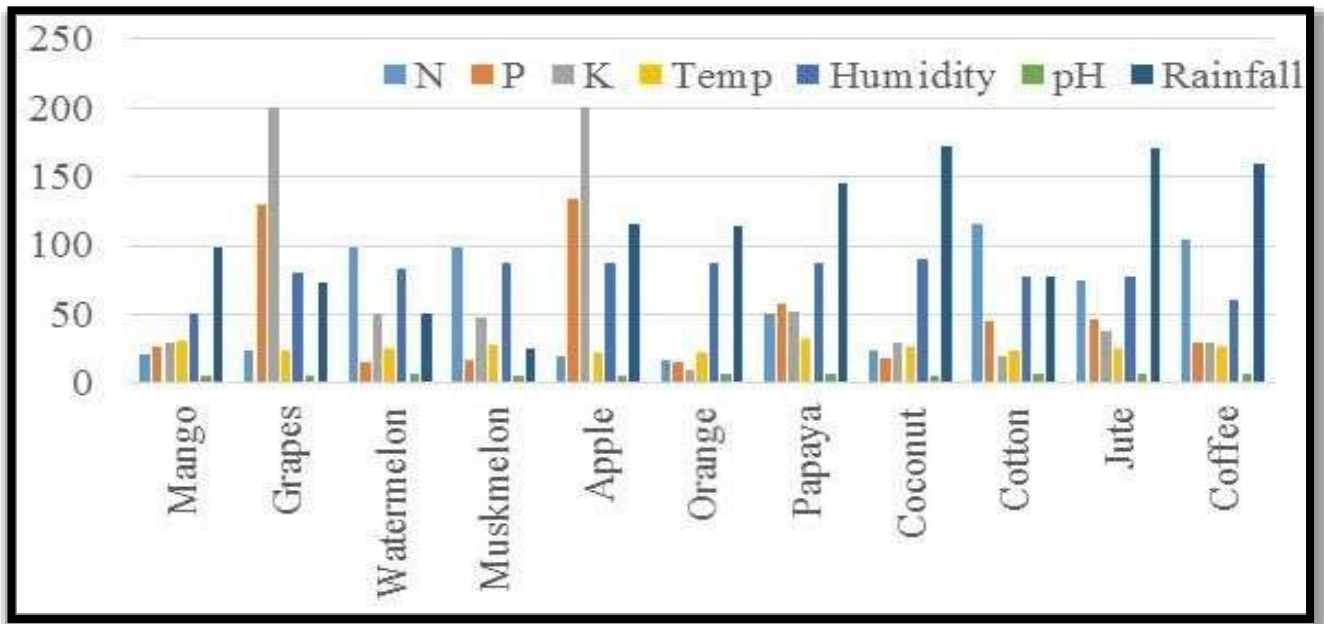


Figure 3. Relations of Various Crops with parameters

Table 3. Accuracy Comparison

S. No	Method	Accuracy
1	Machine learning-based Digital Panchayat System for Farmer Empowerment [proposed]	99.77 %
2	Aparna, K. U. Management of e-Governance Project Implementation in Panchayat Institutions: A Case Study of Kerala. Journal of Polity and Society, 2020; 12(1). https://journalspoliticalscience.com/index.php/i/article/view/31 [2].	93.4 %

3. Conclusion

A web application is designed and developed that could help village Gram Panchayat to work digitally. Various modules with friendly user interfaces help farmers to get information related to seasonal crops and agriculture fertilizers. Further, big societies with a minimum of fifty or more families can directly place bulk orders from the farmers. In this way people will get items at a cheaper price and at the same time the sales of the farmers will be increased. This small effort has improved their quality of life by making them aware of the digital transformation. In the end, the system can promote sustainable development in the village by guiding farmers in farming and labourers in finding work.

Future Scope

The same system can be implemented in regional languages.

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