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AGRIRESPONSE: A REAL-TIME INTELLIGENT QUERY SYSTEM FOR NATIONWIDE AGRICULTURAL ASSISTANCE

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ABSTRACT

Information science developments may be very helpful in advancing the country's sustainable agricultural objectives. In order to address the need for prompt assistance for Indian farmers throughout the country, we provide a framework for a text-based query-response generation system. Building a knowledge base that can respond to enquiries about plant protection from a wide range of farmers is one of the main problems in developing such systems. The call logs from the nationwide farmers' helpline network over the previous eight years are gathered and analysed to provide the necessary information foundation in order to address this issue. Furthermore, in order to administrate the user-input queries and extract pertinent responses from the database, three response-retrieval models with approximate matching and spatial-based searching capability are constructed. A varied question bank with 755 questions spanning 151 Indian crops is created in order to verify the effectiveness of the suggested structure. The models are evaluated using three metrics: Average Response-retrieval time, Crop-weighted Performance Score, and Accuracy Percentage. According to experimental findings, AgriResponse is a helpful framework for real-world applications, with various retrieval models being appropriate for various situations.

I. INTRODUCTION

The majority of the food and textiles produced worldwide come from agriculture, which also plays a big part in the economic growth of the countries. Nonetheless, technical advancements in the agricultural industry are attempting to meet the world's growing food demand as a result of

the growing global population [1]. To assist farmers get the most of the resources at their disposal, these circumstances need the use of the newest, most advanced technology-equipped equipment. In this case, knowledge transmission to farmers throughout the globe depends on the proliferation of information and communications technology (ICT) infrastructure. Every day, more and more farmers are being exposed to mobile phones, which is increasing the need for support centres and assistance lines for issues pertaining to agriculture.

Additionally, since there are around 150 million Indian farmers, the government has always wanted to aid in any manner it can. The Kisan Call Centre (KCC) initiative, which provides extension support to the agricultural community via telephone calls, is one such move in this direction [2]. The Indian government launched a scheme in 2004 to provide farmers nationwide telephone assistance in their native tongue using the toll-free number "1800-180-1551." Furthermore, several studies have shown the program's beneficial effects on farmers' economic circumstances and means of subsistence over time ([3], [4], [5]).

When a farmer phones the KCC with a question, the operator on the other end tries to address the farmer's issue right away. The call is sent to the designated agricultural expert if the KCC operator is unable to respond to the farmer's question right away (Figure 1) [6]. However, this might sometimes result in a delayed response since the experts are not always accessible [7]. In the current study, we provide a text-based query

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answer generating model that may simulate the function of the KCC operator/agriculture expert while keeping this situation in mind. The suggested methodology may be used to respond to enquiries about plant conservation from around the nation.

II. LITERATURE SURVEY

"A review of the challenges and experiences of agricultural development in an artificial oasis,"

J. Zhang, W. Li, H. He, R. Zong, D. Wang, Z. Jia, Y. Wen, T. Wang, Z. Wang, L. Guo, J. Zhang, and H. He

OVERVIEW An artificial oasis is a desert region that may be cultivated and inhabited by humans under human supervision. Although it offers a way to increase urbanisation and population in dry areas, agricultural reclamation in artificial oasis has an adverse effect on the environment.

GOAL around the mostly dry northwest Chinese province of Xinjiang, agricultural production is centred around piedmont oasis. As a result of its agricultural growth, Xinjiang is now China's greatest producer of grapes and cotton. The goal of this research is to better understand oasis agriculture's achievements and difficulties while also suggesting potential remedies. **Methods** We examined a typical instance of agricultural growth during the last 60 years in the Mosuowan irrigation region of Xinjiang using field research, experiments, and data gathering. After summarising the issues and experiences that surfaced, we made some recommendations.

OUTCOMES AND DEFINITIONS We determined that the following four elements are essential to the effective growth of agriculture: (1) water conservation and irrigation infrastructure projects; (2) land consolidation; (3) intensive agricultural management; and (4) advancements in irrigation technology. We discovered a number of issues with sustainable agricultural growth during almost 60 years of fast agricultural reclamation, including: (1) soil salinisation; (2) ecological and environmental degradation; (3) a drop in economic advantages; and (4)

contamination of the soil and environment. In order to potentially address these issues, we suggest the following actions: (1) fully utilise saline-alkaline land through the use of improvers, biological techniques, and drainage infrastructure; (2) create ecological buffer zones for desert oases; (3) modify agricultural management policies; (4) enhance plastic recycling or degradability and modify fertilisation and irrigation plans to lessen soil contamination. **IMPORTANCE** Since oasis agriculture is a delicate and intricate system, scientific management is essential to its long-term viability. Our assessment is intended to serve as a guide for agricultural growth in comparable regions.

"Impact of Kisan Call Centre on Tamilnadu dairy farmers' adoption of technology,"

Jaisridhar, P.

In order to evaluate the effectiveness of Kishan Call Centres (KCC) in addressing crop loss and insect issues in farmers' fields, a study was carried out in 2017 among randomly chosen recipient farmers via phone interviews using a semi-structured questionnaire. MS-Excel 2010 was also used to analyse the 2016 data that was obtained from KCC, which is run by AgriCare Nepal Pvt. Ltd. in Yagyapuri, Chitwan. Every responder was literate, and 76 percent of middle-aged men and 24 percent of women worked in commercial agriculture on their own properties, growing 10–20 ropani of crops and making 5–10 lakh rupees annually. In KCC, almost 78% of farmers reported having insect issues. Pathological issues were the most common, followed by entomological issues, nutritional deficiencies, and others. More than three-fourths of the farmers who benefited expressed great satisfaction, demonstrating the beneficial effects of KCC on Nepalese agriculture. To encourage the use of new technologies, there should be an adequate number of KCCs and an expansion of KCC services.

An investigation on the socioeconomic traits of Kisan call centre recipients and non-recipients in the Mahaboobnagar district of Telangana

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A. Nallusamy and S. Kavitha,

The telecom industry in India is expanding quickly. Every month, the tele-density rate rises as a result of the different services offered. By the end of November 2018, there were 117.18 crore mobile phone users in India, according to TRAI. A study was carried out to determine the socioeconomic status of Kisan Call Centre beneficiaries and non-beneficiaries in the Mahaboobnagar district of Telangana State, taking into account the teleservices. Beneficiary and non-beneficiary farmers were interviewed using a schedule created especially for the research in order to gather primary data. The results showed that the majority of the beneficiary respondents (46.67%) were in the young age group, double-cropped (37.78%), and relied heavily on canal irrigation (38.89%). The majority of recipients had interaction with extension and other agencies (67.78%) and a medium level of education (31.11%). Despite having little agricultural experience (68.89%), the majority of the beneficiaries had a positive opinion of cell phones in farming (61.11%). Regarding the respondents who were not beneficiaries, they were middle-aged (43.33%), illiterate (23.33%), and had a medium degree of education (23.33%). The majority of respondents who were not beneficiaries had a medium degree of agricultural expertise (70.00%), a single planting pattern (60.00%), and a canal as their primary irrigation source (36.67%). The majority of respondents who were not recipients reported having little interaction with extension and other organisations (46.67%), as well as a negative opinion of mobile phones in agriculture (46.67%). Prior to creating any kind of technology transfer programs among farmers, the clientele system and their past are crucial. initiative to raise awareness of KCC, particularly among younger farmers, via the use of mass communication techniques like as television, newspapers, and social media platforms. With two interactive platforms for sharing images and short videos, as well as a voice inquiry system with a toll-free system in

regional languages, it might also be regarded as a unique mobile app.

"The effect of Kisan call centres on the agriculture industry,"

A. Jain, M. Sarkar, H. Singh, G. Seelam, K. Chachra, and A. Jain,

Indian agriculture has faced a number of difficulties. The growth rate and per capita income are produced by this sector. Over 15% of India's total exports and a staggering 28% of its GDP are produced by this industry. These gaps may be mostly filled by using phone and Internet technologies. Agricultural extension will be ensured by constant, reciprocal communication between farmers and agricultural experts. With the assistance of the vast telecom sector, the Department of Agriculture & Cooperation took a historic move on January 21, 2004, when it established Kisan Call Centres (KCC) to provide extension services to the agricultural community. These contact centres' primary goal is to continuously respond to farmers' questions in their native tongue. The Kisan Call Centres now operate out of 14 sites around India. This chapter aims to examine the introduction and implementation of this agricultural community-supporting method.

"Smart Sampark: A method for creating a responsive Kisan call centre system,"

V. Desai, P. Ajawan, and P. Desai,

The country's economic development has been impacted by the COVID-19 outbreak. The epidemic is having an effect on the agricultural sector. In India, agricultural helplines, also known as Kisan call centres (KCC), are established all throughout the nation to answer farmers' questions and provide support during uncertain and trying times. In India, there are 21 KCCs spread among the various states and union territories. Depending on their expertise and the information at their disposal, the agricultural specialists or operators running the hotline at KCC answer the questions of the farmers. The current approach has the drawback of requiring the operator or specialists to be on call at all

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times. Farmers have no point of contact to seek answers to their questions at uncertain times like the epidemic, and calls go unanswered. This document One method for creating an answering system for Kisan Call Centre is called Smart Sampark. It is a conversational system that will make it simple and methodical for farmers to get the answers to their questions. Like the Chabot, Smart Sampark seeks to provide farmers virtual conversational support. The data set made accessible on data.gov.in is used by the suggested system with KCC queries. The responses to the questions were generated using the natural language processing (NLP) approach, and the most comparable answer was produced using the cosine similarity method. The findings are 86% accurate based on 36 months of KCC data from the Belagavi district. By expanding the data set for experiments, the same may be enhanced.

III. SYSTEM ANALYSIS & DESIGN EXISTING SYSTEM

First, the user's queries are processed using methods such tokenisation, POS (part-of-speech) tagging, and parsing in the linguistic approach-based QA models. Afterwards, the matching answers are returned based on the "meaning" of the query. Such systems' drawback is that the data in the organised database can only respond to enquiries within their narrow area of expertise. In the 1960s, researchers began creating systems based on this methodology [12]. Early designs created canonical forms using natural language processing methods, which were then utilised to create a standard database search query. A few additional comparable models based on conversation systems were created later in the 1970s ([13], [14]), with organised databases serving as the information source. Furthermore, a technique for combining knowledge-based question-answering skills with online information was presented by Clark et al. [15] in 1999. When the system was being developed, users were able to find both random and frequently asked questions thanks to this blended approach. Additionally, a lot of models that employed

internet literature as their knowledge base were created around this period ([16], [17], [18]). These models saved data from the internet to the local knowledge database records by using their heuristic functions.

A QA system based on semantic roles, semantic information, and WordNet was created in 2011 by Moreda et al. [19]. They came to the conclusion that the accuracy of the model improved with the amount of semantic information the system used. A biomedical QA system based on semantic connections taken from biomedical literature was created in 2015 by Hristovski et al. [20]. Huang et al. [21] created a QA method based on Wikipedia data extraction the same year. The researchers used Natural Language Processing (NLP) methods in this study, such as dependency parsing, POS, and NER (Named Entity Recognition). Furthermore, Xie et al. [22] developed an ontology-based QA system using comparable methods, such as POS tagging, syntactic analysis, and semantic connection query keywords.

To forecast the predicted replies, statistically based models examine the questions posed by users. These techniques evaluate the documents according to a number of similarity criteria in order to determine how closely the applicant's responses match the input question. Usually, a corpus labelled with the particular categories is used to train the models, either manually or via machine learning methods. These models often use SVM, Naive-Bayes, K-nearest neighbour, and other approaches. [23]. IBM researchers created a statistical quality assurance system in 2000 that classified texts using a maximum-entropy model based on bag of words attributes [24]. Using similar methods, several further text classification-based models were created later in the 2000s ([25], [26], [27]). Additionally, a statistical chunker-based model was created by Soricut et al. [28] to divide the input queries into terms that the search engine would understand. By using N-gram co-occurrence statistics to

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choose the best response, the created system was also able to provide answers to challenging problems.

Higashinaka et al. [29] created corpus-based QA for why-questions in 2005 by training a ranker of response candidates based on characteristics using machine learning methods. Later, in 2009, researchers presented a QA system that classified the questions using an enhanced Bayesian approach based on ontology [30]. In 2013, Toba et al. [31] suggested a hierarchy of classifiers to find high-quality responses in community QA archives. Additionally, Medved et al. [32] created an Automatic QA system for Czech in 2016 by combining tree distance between the query and potential responses with TF-IDF. Similar to this, Lima et al. [33] created a multi-level tag suggestion system that is coupled with an external knowledge base QA system. The system sorts the tags into several semantic levels according to how often they are used. Additionally, in 2019, Ha et al. [34] created a QA system for medical multiple-choice questions by fusing an information retrieval and neural technique. Using the GPT-2 language model, Oniani et al. [35] created and assessed a number of language models for Covid-19-related QA systems in 2020. They then used transfer learning to retrain the model using the Covid-19 open research dataset. Additionally, in 2021, Aithal et al. [36] created a system for generating QA pairs and implemented a question similarity technique that mimics human thought processes to determine if the questions are answered.

Disadvantages

Within an established system, it is discovered that a few crops dominate the base, whereas many crops are present with few records. Furthermore, it is noted that the crops with less entries in the knowledge base are the ones whose incorrect responses the models have returned. Regarding the models' RRT, a similar distribution was seen; it was noticed that although many questions were

answered with quicker RRT, those pertaining to the "famous" crops took longer.

PROPOSED SYSTEM

The goal of this project is to create AgriResponse, a system that allows farmers to submit textual questions on plant protection and get responses. When the specialists are not present, the helpline operators might utilise the model to get a second perspective or look for options. Developing a comprehensive knowledge base to address national enquiries is one of the difficulties encountered while establishing such a system. Creating a response-retrieval model that can handle mismatched words is the second step in maximising search time without sacrificing model accuracy. Using the query-calls records kept on the Open Government Data Platform India [8] and on the KCC data servers during the last eight years, we have developed a knowledge base to address the first difficulty. Every month, the KCCs make the information on the calls publicly accessible. These documents include details on the farmer's location, the question they asked, the response they received, and a host of other things.

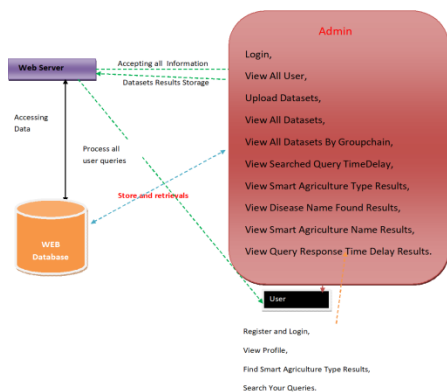
Advantages

- **Creation of AgriResponse System:** The research presents the AgriResponse system, a unique text-based query-response generating model intended to answer questions from farmers throughout the country on plant protection.
- **Error-Tolerant methods:** This feature improves the system's resilience in practical situations by including methods to tolerate spelling errors in user queries and the knowledge base.
- **numerous Answer Support:** Given that various locations may have different remedies or treatments for a certain problem, AgriResponse may provide numerous responses for a single inquiry when needed.
- **nationwide-Level Efficiency:** AgriResponse seeks to guarantee its effectiveness on a nationwide level, offering more thorough assistance to a greater number of farmers, in contrast to current models that test on a district level.

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- Publicly Accessible Resources: By making the generated knowledge base, question bank, and code for response-retrieval models publicly accessible, the research effort encourages repeatability, improves transparency, and stimulates further study in the area.
- Incorporation of Multilingual Data: The research customises the model's methodology to account for the complexity of mixed languages and translation mistakes, acknowledging the multilingual character of the KCC database.
- Resolving the Absence of Reliable measurements: AgriResponse aids in the assessment of QA models in this setting by recognising the lack of trustworthy performance measurements in earlier research.

SYSTEM ARCHITECTURE



IV. IMPLEMENTATION

Modules

Admin

The administrator must use a working user name and password to log in to this module. Following a successful login, one may do several tasks including seeing all users, Add datasets, Access Every Dataset, Access Every Dataset By Group Chain, See the results for the searched query time delay, smart agriculture type, disease name found, smart agriculture name, and query response time delay.

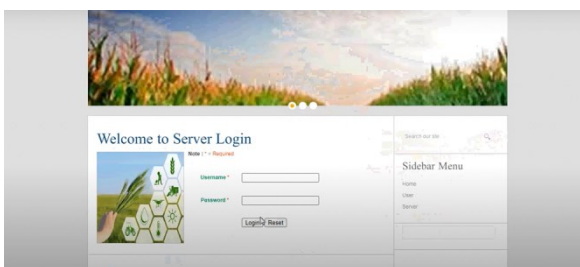
View and Authorize Users

The administrator may see a list of all registered users in this module. Here, the administrator may see the user's information, like name, email, and address, and they can also grant the user permissions.

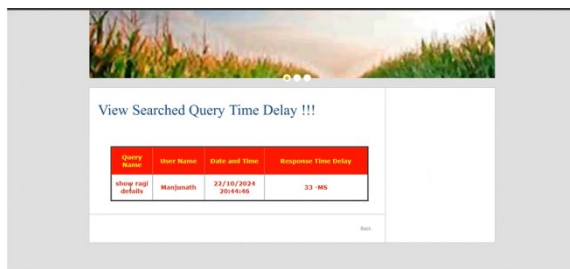
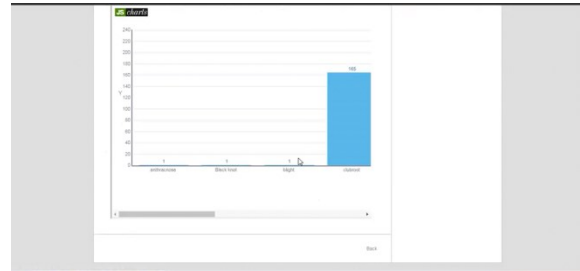
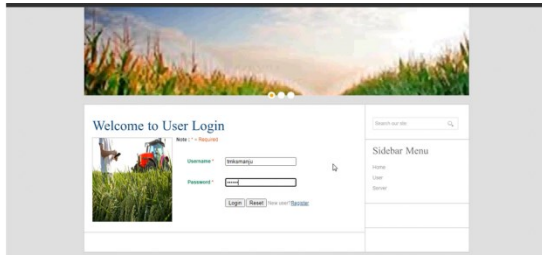
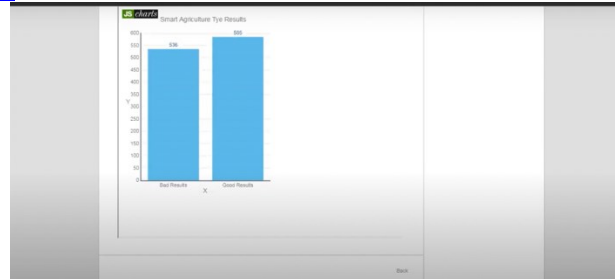
User

A total of n users are present in this module. Before beginning any actions, the user needs register. Following registration, the user's information will be entered into the database. Following a successful registration, he must use his password and authorised user name to log in. Following a successful login, the user may do several tasks such as registering and logging in, seeing their profile, finding results related to smart agriculture, and searching for their queries.

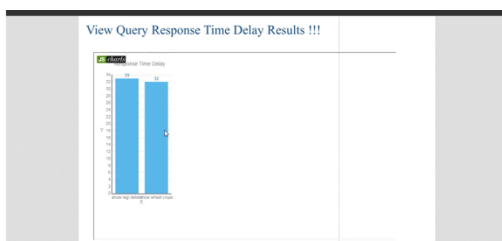
V. SCREENSHOTS



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VI. CONCLUSION

The agricultural industry requires mechanisms to handle farmers' requests for assistance as a result of the worldwide expansion of ICT infrastructure. Furthermore, there is presently a paucity of experience with agriculture-related helplines and support centres [7]. The livelihoods of farmers and the country's economy might be significantly impacted by delays in the experts' advise. In light of this, we suggest Agri Response, a framework that gives Indian farmers real-time text-based answers pertaining to plant protection. The suggested framework may also be used by the hotline operators as a second opinion to the guidance of the experts.

Developing a knowledge base of questions and answers pertaining to different crops cultivated in India was one of the challenges encountered during the building of the suggested framework. Second, creating intelligent query-response retrieval systems to

improve response-retrieval time and accuracy. A novel approach to building a knowledge base has been proposed as a remedy, using the call logs of the farmers' hotline facilities. Furthermore, three distinct models with varying searching capabilities for answer retrieval are constructed (RRM1, RRM2, and RRM3). A question bank with 755 enquiries spanning 151 crops is used to verify the models. Three measures (AP, CWPS, and ARRT) on the question bank are used to assess the models' performance. According to the trials, RRM1 performs the worst in terms of ARRT (11.60 sec) but has the greatest AP and CWPS (87.41% and 98.5%, respectively). The results show that RRM2 performs best in ARRT (2.29 sec) and worst in AP and CWPS (70.59% and 92.91%, respectively). In contrast, RRM3's performance was on par with the top models in all parameters (AP = 85.43%, CWPS = 97.15%, and ARRT = 4.18 sec). Consequently, it can be said that RRM3 is an excellent response-retrieval model option for our goal. In order to improve the system's AP and CWPS, we want to combine knowledge bases from many sources (QA forums, blogs, publications, etc.) in further work. Additionally, in order to improve framework performance, we want to combine machine learning with sophisticated string-matching algorithms.

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