Farm's Smart BOT

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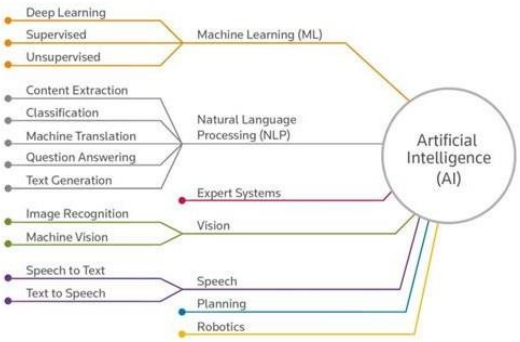
Abstract- In India, agriculture plays an indispensable role to upgrade the economy. The most important problem prevailing among the Indian farmers is the difficulty of choosing the right crop according to the specific region. This bot provides a complete solution which benefits the farmers to increase their productivity. Various algorithms have been analysed and the best method that suits various purposes are discussed. The proposed bot is platform independent as it supports its functionality in a multi-operating system. This is being implemented using Natural Language Processing (NLP) for text classification and yoloV3 for object detection. The Farm's Smart BOT provides a complete solution of conversational system along with the integration of various predicting modules like Crop detection, Soil detection, Crop disease detection, suggestions about crop rotation and Weather forecasting.

Keywords: API, Chatbot, Natural Language Processing (NLP), YOLO V3.

I. Introduction

A chatbot is always created with a view of solving a single problem with the help of Natural Language Processing. Building a chatbot with the help of text classification for specific problem statements has been carried out for the past several years. Instead of solving a single problem with the help of a chatbot, all necessary problems can arrive at a solution with the help of a chatbot. Developing a multi-purpose chatbot will help the users with lots of conveniences and also will solve a lot of use cases. Multi-purpose chatbots can be very useful and will be a very useful replacement for farmer assistance, medical assistance for minor consultations, safety and security purposes, cooking, farming, accident reporting, etc. People can use the chatbot whenever they need as well as for whatever purpose they need. There are various kinds of chatbots for various purposes. Chatbots were traditionally developed for solving a single purpose. They are developed with the help of various machine learning algorithms for applying Natural Language Processing. NLP is the way through which machines can understand the language spoken by humans. The Chatbots are more accurate and restricted, since these kinds of chatbots solve a single and complicated problem.

The various added features in the BOT include the detection of soil type, crop variety detection, crop disease analysis and solution providing, various information about crop rotation and also provides necessary information required by farmers including forecasting details and providing solutions to all the queries raised by farmers. Artificial Intelligence is a wide branch of Computer Science that is capable of performing high rated tasks and is concerned in building smart machines that require human intelligence. AI with several tactics is an interdisciplinary science, but the advancements in deep learning and machine learning has created a paradigm shift in the tech industry. The most important goals of AI are reasoning, knowledge representation, learning, planning, Natural Language Processing (NLP), perception and the ability to move and manipulate objects. Various tools have been used in AI which includes the versions of search and mathematical optimization, Artificial Neural Network and methods related to probability, statistics and economics.



Deep learning is a part of machine learning in Artificial Intelligence that has capability of learning unstructured or unlabelled data. It can also be stated as Deep Neural Learning or Deep Neural Network. DL is an AI function which acts as the replica of the human brain in processing data and thereby plays a major role in pattern creation and decision making. Processing data includes detecting objects, speech recognition, language translation and thereby supporting for Decision making. In this proposal, the chatbot has been implemented using Natural

Language Processing which is a deep learning technology. NLP is a field that acts as a bridge between computer understandable language and human language. It is a field of AI in which computers can make the analysis, understand and derive proper meaning from human language in a very efficient and smart manner. Farm's Smart Bot NLP plays a major role. The farmer interacts with the BOT through his own language (might be a regional specific). This interaction might be any kind of queries, clarification, and suggestions required to increase the crop production. These kinds of queries that are posted by the farmers are recognised by the deep learning concept NLP whichhas a capability to separate the texts in the form of specific tokens.

Techniques of Natural Language Processing Covered

1) Named Entity Recognition (NER)
2) Tokenization
3) Stemming and Lemmatization
4) Bag of Words
5) Natural language generation
6) Sentiment Analysis
7) Sentence Segmentation

1.1 Named Entity Recognition (NER)

NER technique is one of the most advantageous techniques in Semantic analysis, Semantics is something conveyed by the text. In this technique, the algorithm takes a phrase or paragraph as the input and identifies all the nouns or names present in it.

There are many popular use cases of this algorithm and are mentioned below,
News Categorization: This algorithm automatically scans all the news articles and extract out all sorts of information and data like people, individuals, companies, organizations, celebrities name, places from that article. Using this algorithm,one can easily classify news content into different categories.

Efficient Search Engine: The entity recognition algorithm applies to all the news, articles and results to extract relevant tags and stores them separately. This will boost up and enhance the searching process and results in providing an efficient search engine.

Customer Support: There are thousands of responses provided by people concerning heavy traffic areas on twitter on a daily basis. If Named Entity Recognition API is used then it can easily bepulled out (all the keywords or tags) to inform concerned traffic police departments.

1.2 Tokenization

Tokenization, it is basically splitting of the entire text into the list of tokens, lists can be anything such as words, characters, sentences, numbers, punctuation, etc. The two main advantages of Tokenization - one is to reduce search with a significant degree, and the second is to be effective in the use of storage space.
The basic steps of any NLP problem include the process of mapping sentences from character to strings and strings into words because to understand any text or document, the meaning of the text must be understood by interpreting words/sentences present in the text.
Tokenization is an integral part of any Information Retrieval (IR) system, which not only involves the pre-processing of text but also generates tokens respectively which are used for the indexing/ranking processes.

1.3 Stemming and Lemmatization

The increasing size of information and knowledge on the online is incomparably high from the past number of years. This large information and knowledge demand necessary tools and techniques to extract inferences with a lot of ease.
“Stemming is that the method of reducing inflected (or generally derived) words to their word stem, base or root kind - typically a written sort of the word.” for instance, what stemming will, primarily it cuts off all the suffixes. thus once applying a step of stemming on the word “playing”, it becomes “play”, or like, “asked” becomes “ask”.
Lemmatization typically refers to try to do things with the right use of vocabulary and morphological analysis of words, unremarkably reaching to take away inflectional endings solely and to come the bottom or wordbook sort of a word, that is understood because the lemma. In easy words, Lemmatization deals with lemma of a word that involves reducing the form once understanding a part of speech (POS) or context of the word in any document.

1.4 Bag of Words

Bag of words technique is employed to pre-process text and to extract all the features from a text document to use in Machine Learning modelling. It's conjointly an illustration of any text that elaborates/explains the prevalence of the words inside a corpus (document). It's conjointly referred to as "Bag" because of its mechanism, i.e. it's solely involved with whether or not illustrious words occur within the document, not the placement of the words.

Let's take associate degree example to grasp bag-of- words in additional detail.

"Rita was angry on Sunil and he was angry on Ritesh."
"Rita love animals."
"Rita", "was", "angry", "on", "Sunil", "and", "he", "Ritesh", "love", "animals"

Then create these documents into vectors or converting a text into numbers is called vectorization in ML for further exhibiting. Presentation of "Rita was angry on Sunil and he was angry on Ritesh" into vector form [1,1,1,1,1,1,1,0,0] and the same as in, "Rita love animals" having vector form as [1,0,0,0,0,0,0,0,1,1]. So, the bag-of- words procedure is largely used for featuring generation from text data.

1.5 Natural Language Generation

Natural language generation (NLG) may be a technique that uses raw structured knowledge/data to convert it into plain English (or any other) language. It also can be known as knowledge storytelling. This method is extremely useful in several organizations wherever an outsized quantity of information is employed, it converts structured knowledge into natural languages for a much better understanding of patterns or careful insights into any commercial. NLG makes knowledge perceivable to all or any by creating reports that area unit primarily data-driven, like, stock-market and monetary reports, meeting memos, reports on product needs, etc.
There are many stages of any NLG;

1. Content Determination: Deciding what are the main content to be represented in text or information provided in the text.
2. Document Clustering: Deciding the overall structure of the information to convey.
3. Aggregation: Merging of sentences to improve sentence understanding and readability.
4. Lexical Choice: Putting appropriate words to convey the meaning of the sentence more clearly.
5. Referring Expression Generation: Creating references to identify main objects and regions of the text properly.
6. Realization: Generating and optimizing text that should tail all the norms of grammar (like syntax, morphology, orthography).

1.6 Sentiment Analysis

It is one among the foremost natural language processing techniques. With sentiment analysis, one will perceive the emotion/feeling of the transcription. Sentiment analysis is additionally referred to as Emotion AI or Opinion Mining. The basic task of Sentiment analysis is to search out whether or not expressed opinions in any document, sentence, text, social media, reviews are positive, negative, or neutral, it's additionally referred to as finding the Polarity of Text. Sentiment analysis typically works best on subjective text information instead of objective information. Generally, objective text information is either statements or facts that doesn't represent any feeling or emotion. On the opposite hand, the subjective text is typically written by humans showing emotions and feelings.

For example, Twitter is all crammed up with sentiments, users are addressing their reactions or expressing their opinions on every topic whichever or where doable. So, to access tweets of users in an exceedingly period of time situation, there's a robust python library referred to as 'twippy".

1.7 Sentence Segmentation

The most elementary task of this method is to divide all text into meaning sentences or phrases. This task involves distinguishing sentence boundaries between words in text documents. the majority languages have punctuation marks that square measure bestowed at sentence boundaries, therefore sentence segmentation additionally cited as sentence boundary detection, sentence boundary illumination or sentence boundary recognition.There are many libraries available to do sentence segmentation, like, NLTK, Spacy, Stanford Core NLP, etc, that provide specific functions to do the task.

2. Literature Review

In this section, the basics steps for crop detection, crop disease detection, soil detection have been discussed and the classification using image processing are explained in detail.

Image Acquisition: The images of the crops are to be captured by the farmer using a camera and this image will be in RGB (red, green, blue) form. The colour transformation structure will be created for the RGB crop images (H. Al-Hiary, 2011).

Image Pre-processing: Pre-processing is the most important and crucial process. The noise in the image and other unnecessary objects must be removed and clipped off. Hence the crop images have to be cropped to get the targeted image region.

Smoothing filter is required for the smoothening of images and the contrast of the image is also enhanced. To enhance the crop disease images, histogram equalization (Dr. K. Thangadurai) which distributes the intensities of image has to applied on that particular image.

Image Segmentation: It is the process by which the algorithms partition the crop images into various parts consisting of images with same features or having some similarities.

Otsu Threshold Algorithm: In this proposal, one of the most efficient algorithms has been used for image segmentation which is called to be Otsu Threshold Algorithm. In this process the binary images have been created from grey level images by setting a threshold for pixels. This algorithm is defined as follows (Mrunalini R. 2012).

According to the threshold, Separate pixels into two clusters

Then find the mean of each cluster.

The diseased crop is identified by the change of colour pattern. Hence, the natural colour (green) of the crop is helpful for the disease detection of the infected crop. Then the green pixel is masked and removed if the green pixel intensity is less than the threshold value and such images are identified to be the diseased ones.

Feature Extraction: Feature Extraction also plays an important role for object detection and hence, here it is useful for crop detection, soil detection and crop disease detection. It is the process of identifying and extracting the most important features of a crop image and few of those are colour, texture, morphology, edges, etc.

Classification: There are various algorithms that can be implemented for classifying various soil types, crop types and crop diseases.

In this paper (Khirade, S. D., 2015), CNN classifier has been used for the classification of the diseased crops. CNN classifiers feature the vectors as neurons. The results shown by using this CNN classifier are not that much efficient and also it consumes a lot of processing time.

It is important to accurately detect and classify the plant disease for the successful and increased production of the crop yield and thereby provide knowledge for the farmers regarding their crop diseases. In this proposed method, in order to provide highly efficient accuracy of crop disease detection, YOLOV3 algorithm has been implemented. YOLOV3 also provides super-fast processing results. As it takes less computational time as compared to SSD, CNN, Faster RCNN. YOLOV3 is a very optimal algorithm for tiny object detection and even for minute objects the results are as expected.

In this paper (Arora, B., 2020) Arora, B., Chaudhary, D. S., Satsangi, M., Yadav, M., Singh, L., & Sudhish, P. S. focused on the development of chatbot for generalised farming related queries. Along with the general chatbot, it focused on predicting only two of the most important features of farming – Crop disease prediction and Weather forecasting. It is implemented by a trainable sequence-to-sequence learning model with the objective of achieving conversational task-oriented systems. The approach exploits a multi-layered Long Short-Term Memory (LSTM) unit to map the input sequence to a corresponding output sequence. Convolutional Neural Network model has been implemented for disease prediction. As discussed earlier (Khirade, S. D., 2015), CNN classifiers do not focus on providing super-fast results as it consumes more time for processing the output. CNN does not focus on keen and clear identification and detection of peculiar tiny images and here is where the accuracy is dropped off. In the current system CNN has been replaced by YOLOV3 thereby, providing speedy and accurate results.

This proposal (M. Brahimi, 2018) by M. Brahimi, M. Arsenovic, S. Laraba, S. Sladojevic, K. Boukhalfa, A. Moussaoui concentrates on the disease detection of the crops. In this paper, they have focused on directing the images as the input to the machine learning model. This proposal is all about developing an Image-Based Plant Disease Detection Application Using Deep Learning. The techniques that have been used for the implementation are Deep convolutional neural networks and transfer learning. This involved the usage of a large number of parameters. Since there are a large number of parameters, it required a large computation time and hence providing a great drawback.

It has ended up with the solution of providing very less detection features, very less detection features and the

major drawback is that their proposal is not integrated with the chatbot. They have provided a solution which facilitates only disease detection and not any other features like crop detection, soil detection, weather forecasting and even it does not provide a conversational system thereby, not facilitating the farmers with necessary guidance about the field and farming activities.

But in this current proposal, a complete solution with the integration of chatbot has been proposed. The most important characteristic to be considered while executing chatbot is the processing of text and this is being implemented using NLP techniques using SVM (Support Vector Machine). The algorithm SVM (Helmi Setyawan, M. Y., 2018) is much stronger than any other algorithms including MNB (Multinomial Naive Bayes) because MNB always works on the snippet dataset whereas SVM concentrates on full length analyses. Support Vector Machine is often used as baseline methods for text classification and it goes best and provides better results even for longer documents.

3. Limitations of Existing System

The main limitation of Naive Bayes is the assumption of independent predictor features. Naive Bayes indirectly commences that all the attributes are mutually self-determining. In real life, it's almost impossible that there exists a set of predictors that are completely independent or one another. If a categorical variable has a category in the test dataset, which was not detected in the training dataset, then the model will allocate a 0 (zero) probability and will be unable to make an estimate. This is frequently recognized as Zero Frequency. To solve this, smoothing technique can be used. The assumption that all features are independent is not usually the case in real life so it makes naive Bayes algorithms less accurate than complicated algorithms. Speed comes at a cost!

The most important limitation of the existing chatbots is that they are not platform independent and are supported only for android operating systems (OS). The existing systems also do not support a regional language which actually provides an added advantage of convenience when implemented.

In weather forecasting, it is necessary for the farmer to provide the input of the place and hence there is no feature of automatic recognition of the location by the BOT. The concept of Crop Rotation was not focused while designing, if implemented, would give better interpretation of suggestion of crops to farmers. Contrasting humans, a chatbot has no sentiments. However, they are pretty essential to keep a conversation going the right way. The customer service executives can understand the customers' emotions and respond accordingly, but a chatbot may not be able to do so.

One of the greatest disadvantages of the existing chatbots is that they have been designed to handle. Capable of handling First-level queries only. They may not be able to solve complex queries, need to train them to converse with Farmers in the right way also need to structure and optimize the knowledge base in a bot-friendly way. This will allow the chatbot to scan the content effectively and pull out relevant solutions for each customer request. Chatbots require ongoing review, maintenance, and optimization in terms of their knowledge base and the way they are supposed to communicate with Farmers. We need to feed them with new, insightful data (content) that they can use to respond to customer requests and questions. They should be able to abstract the most pertinent and supportive content to solve customers' problems.

4. Features of Proposed System

The BOT provides the best solution integrating all the necessary functionalities out of which few were separately implemented in the existing systems. Lot of issues and hardships have been faced by the farmers and are hence at the verge of digging out the best solution.

Providing a wholesome solution is very mandatory and that should be featured to satisfy all the needs of the farmers. Natural Language Processing (NLP) is one of the twigs of AI that provides the machines the ability to read, understand, and deliver meaning. NLP has been very successful in healthcare, media, finance, and human resource. It also proves to be successful in agriculture too. The most general form of unstructured data is texts and speeches. It's plenty but hard to extract useful information. If not, it would yield an extensive time to mine the information. Speech and written text contain rich knowledge. It's because we, as intellectual humans, use writing and speaking as the key form of communication. NLP can analyse these data for us and do tasks like sentiment analysis, cognitive assistant, span filtering, identifying fake news, and real-time language translation.

4.1 Crop Type Detection

In the modern era, the deep neural network is the prominent tool in the agricultural industry for providing support to farmers in monitoring crop yield based on the weather conditions. The recurrent neural network (RNN) is

employed for spotting the suitable crop for the observed environmental conditions from the field and also provides suggestions about whether the desired crop can be grown in that field or not. The environmental parameters such as humidity, temperature, rain and moisture are obtained through the sensors and fed as input to recurrent neural networks. Then, the recurrent neural network identifies the suitable crop by classifying the crop based on the climatic conditions.

4.2 Soil Detection

Soil is an important key factor for agriculture. There are several soil varieties in India. In order to envisage the type of crop that can be cultivated in that specific soil type we need to understand the features and characteristics of the soil type. Machine learning techniques using YOLO V3 provides a flexible way in this case. Categorizing the soil bestowing to the soil nutrients is much advantageous for the famers to predict which crop can be cultivated in a particular soil type. Data mining and machine learning is still an emerging technique in the field of agriculture and horticulture. Machine learning is implemented to classify soils built on various detectable features such as soil moisture content, soil quality, soil pH,soil nutrients, soil structure and soil quality. A huge amount of literature is available for soil classification methods using the machine learningmethods.

4.3 Disease Detection

Crop diseases are a most important risk to food security, but their rapid detection remains tough in many portions of the world due to the lack of the necessary infrastructure. The combination of growing global smartphone penetration and recent advances in computer vision made possible by deep learning has paved the mode for smartphone- assisted disease diagnosis. Training a deep convolutional neural network using a dataset of 54,306 images of diseased and healthy plant leaves collected under controlled conditions. Overall, the method of implementing and training deep learning models on progressively large and publicly available image datasets presents a clear path toward smartphone-assisted crop disease diagnosis on a massive global scale.

4.4 Disease Preventive Measures and Solution

The BOT not only detects the diseases in the crops but also provides preventive measures for the farmers. The farmers thereby get the best solution providing remedies to take severe action against diseases. It also specifies what type of pesticides to be used which helps prevent diseases in crops.

4.5 Weather Forecasting

Weather conditions around the world change rapidly and continuously. The accurate forecasts are vital in today's daily life. From agriculture to industry, from traveling to daily commuting, we are heavily dependent on weather forecasts. As the entire world has been facing difficulty from the continuous climate change and its side effects, it is very important to forecast the weather conditions without any fault to ensure easy and seamless mobility, as well as safe day to day operations.

4.6 Conversational System

The queries of the farmers must be handled and the BOT should provide the best solution to sort all those queries and solve the issues. Farmers might post queries regarding the type of crop to be planted in his region the fertilizer & pesticides to be used and the best market for sales and all other related queries which have to be immediately taken into consideration in order to yield the best production.

4.7 Crop Rotation

Certain crops require rotational cultivation and harvesting in order to increase the fertility of the soil. The BOT provides suggestions and complete details about the crop rotation. It also specifies what kind of crop should be rotationally planted and at what time the crops must be harvested for another rotational growth of the crop.

4.8 Platform Independent

Usually, the chatbots support performing its functionality in Android operating systems and are not adaptable in other operating systems but the proposed BOT has this special feature of platform independent and is capable to function in various operating systems. This feature is actually achieved by developing the bot using flutter which supports multiple Operating Systems.

Flutter is a UI software development kit created by Google which is an open-source platform. It is used to develop

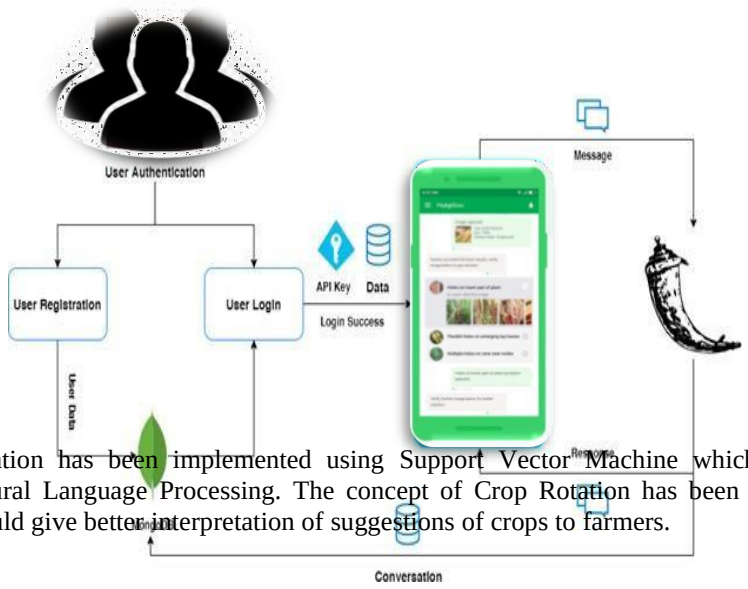
applications for Android, iOS, Linux, Mac, Windows, Google Fuchsia, and the web from a single codebase.

4.9 Automatic Location Access

It is mandatory for a farmer to know the climatic condition and the current status of the weather in his current location. Farming is totally dependent on the weather status of that particular area. The BOT helps the farmers in detailing the weather status report and hence guiding them with further decisions. The bot is responsible for accessing the location on its own without any interrupted location input from the farmers. So, this feature adds to the greatest advantage for the farmers through which they could prepare their fields and take up precautionary steps.

5. Proposed Work

The proposed work is all about integrating the existing solutions to provide the most efficient result. This has been built to support various operating systems like Android, iOS, macOS, Windows, Linux, Google Fuchsia and Web Platform using flutter. Hence, it is a platform independent solution. It has been intended to provision various features like Crop detection, Soil detection, Crop disease detection, Solution to crop diseases, detailing about Crop rotation methods and Weather forecasting.



The text classification has been implemented using Support Vector Machine which is a text classification algorithm for Natural Language Processing. The concept of Crop Rotation has been focused in this proposed solution which would give better interpretation of suggestions of crops to farmers.

5.1 Discussion

The bot architecture explains the entire process to be carried out in the application. It initially starts with the user authentication process where the user first registers the details in the BOT. The information about the user along with their password gets stored in the MongoDB which is then accessed and verified at the time of user authentication.

When the Login process is successful, the user(farmer) can post any kind of queries to the Chatbot for which quick responses gets generated with the help of the Machine Learning Model which is trained using TensorFlow. The BOT also helps the farmers with all the predefined features like providing1them with the best solution for crop diseases, details about the efficient crop growth, suggest the fertizers to be added to the crops for its efficient growth. It also provides suggestions to increase the production to sell the crops at the best price.

The algorithms used for Crop detection, Crop disease detection, Soil detection is the object detection algorithm called YOLO V3. The existing systems focused on the individual functionalities and they lacked in providing a wholesome solution for the farmers. They are restricted to fulfil any of the two to three functionalities out of the following features like crop detection, soil detection, crop disease detection, weather forecasting, answering the queries of the farmers, decision making direction. For agricultural purposes, it is important that the details about field situations, such as air and soil temperature, weather forecast, soil moisture, disease detection capabilities and other relevant variables, be rapid and easily available for use by farm management systems, by specialists, or the

farmer itself in the decision-making method. For this purpose, a chatbot was developed using sequence-to sequence learning, a type of generative approach. The model learns a mapping between questions and its appropriate responses which helps in evaluating strengths and weaknesses of the system.

The one of the existing systems developed involves the creation of three modules – conversation system module, disease detection module and weather prediction module. One more is the top module connecting all the three modules. In weather forecasting, it is necessary for the farmer to provide the input of the place and hence there is no feature of automatic recognition of the location by the BOT. The existing systems are being implemented using less accurate algorithms for text classification and one such algorithm is theMultinomial Naive Bayes.

6. Conclusion

Agriculture is the greatest support for the nation. Farmers are the backbone of the country and hence it is important to satisfy the needs and requirements of the farmers and help them increase the production of the crops there by improving the economy of the Nation. The primary objective of the FARM'S Smart BOT is to provide the farmers with a handy and portable virtual interactive farming assistant that can communicate with farmers. It is wholly designed for the farmers and hence the target consumers are the Farmers- The Nation's Pride. The BOT, not only helps farmers get best crop recommendations but it also helps them better nurture their crops, store their crops so as to increase shelf life of crops, as well as help them find best rates at which they can trade their crops in nearby markets.

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