

# USER-FRIENDLY STATIC CHATBOT IN IOT DEVICE FOR INTERACTION WITH FARMERS IN INTEGRATED RICE-FISH FARMING

Dr T. M. Usha<sup>a,\*</sup>, Rohith Kumar Ragala<sup>b</sup>, Dedipya Edupallic<sup>c</sup>,  
Hari Lakshmi A S<sup>d</sup>, Sudhishna DVVK<sup>e</sup>, SVDS Raghuram Akula<sup>f</sup>,

<sup>a</sup> Professor, Dept. of CSE(Internet of Things), Ramachandra College of Engineering,  
Eluru, Andhra Pradesh, India, [ushawin20202@gmail.com](mailto:ushawin20202@gmail.com)

<sup>b,c,d</sup> UG Student, Dept. of AI&DS, Ramachandra College of Engineering, Eluru,  
Andhra Pradesh, India,

[rrkips2003@gmail.com](mailto:rrkips2003@gmail.com), [edupalldedipya@gmail.com](mailto:edupalldedipya@gmail.com), [harinisugumar173@gmail.com](mailto:harinisugumar173@gmail.com)

<sup>e</sup> UG Student, Dept. of CSE(IoT), Ramachandra College of Engineering, Eluru,  
Andhra Pradesh, India, [sudhishna1009@gmail.com](mailto:sudhishna1009@gmail.com)

<sup>f</sup> UG Student, Dept. of CSE, Ramachandra College of Engineering, Eluru,  
Andhra Pradesh, India, [akularaghuram55@gmail.com](mailto:akularaghuram55@gmail.com)

## ABSTRACT

This paper introduces an AI chatbot designed specifically for integrated rice-fish farming, which combines the cultivation of rice crops with fish rearing in the same ecosystem. The chatbot utilizes artificial intelligence techniques, including natural language processing and machine learning algorithms, to provide real-time information and support to farmers engaged in integrated rice-fish farming systems. It offers guidance on various aspects such as crop cultivation techniques, fish species selection, water management, pest and disease control, and market trends. By continuously learning from user interactions and analysing data, the chatbot tailors its responses and recommendations to meet the specific needs of individual farmers. The integration of AI technology in agriculture has the potential to revolutionize traditional farming practices, optimize resource utilization, increase productivity, and enhance food security. The proposed AI chatbot for integrated rice-fish farming serves as a valuable tool for farmers, empowering them to leverage AI capabilities and make informed decisions, ultimately promoting efficient and sustainable farming practices within the context of integrated rice-fish ecosystems.

## KEYWORDS

*AI Chatbot, Integrated Rice-Fish Farming, Aquaculture, Integration, Water management, pH maintenance, Temperature fluctuations, Pesticide restrictions, Labor-intensive processes, Innovative strategies, Natural Language Processing, Machine Learning Algorithms, Real-time Information*

## 1. INTRODUCTION

Integrated farming systems have emerged as a sustainable and profitable approach to agriculture, offering multiple benefits such as increased productivity, resource efficiency, and ecological balance. One such integrated farming practice is Rice-Fish farming, which involves the concurrent cultivation of rice and fish in the same field or water body. This integrated approach harnesses synergistic interactions between rice and fish, leading to improved nutrient cycling, reduced pesticide use, and enhanced overall farm productivity. However, traditional methods of managing integrated Rice-Fish farming present several challenges that hinder optimal production and quality maintenance. Farmers engaged in integrated Rice-Fish farming face various obstacles throughout the farming process, including proper water regulation,

maintaining suitable pH levels, coping with temperature fluctuations, restricted pesticide use, and labour-intensive tasks. These challenges can impact the quality of the produce and limit the profitability of the farming venture. Therefore, there is a growing need for technological interventions to address these limitations and improve the efficiency and sustainability of integrated Rice-Fish farming. This research paper aims to develop an IoT-based smart monitoring device specifically designed for integrated Rice-Fish farming. The device aims to provide farmers with an easy and effective means of monitoring and maintaining their farms. By leveraging IoT technology, the device enables continuous real-time monitoring of crucial parameters such as water temperature, pH, dissolved oxygen, salinity, turbidity, ammonia nitrogen, and oxygen demand. The collected data is transmitted to a central monitoring device, which provides real-time feedback and alerts to farmers through LED indicators, mobile applications, and websites.

The proposed smart monitoring device offers numerous advantages to farmers engaged in integrated Rice-Fish farming. It streamlines the maintenance and monitoring processes, reduces labor requirements, and improves productivity. With automatic alerts and notifications, farmers can promptly address any issues related to water quality, ensuring optimal conditions for both the rice crop and fish. Additionally, the device enables the automatic functioning of actuators such as water pumps and fish feeders, which can be controlled based on the sensor data, promoting efficient resource utilization and precise farming practices.

## 2. LITERATURE REVIEW

S. No	Paper Title	Year	Methodology	Results	Limitations
1	The Potential of Artificial Intelligence for Integrated Rice-Fish Farming.	2019	Systematic literature review on AI in rice-fish farming. 27 articles analyzed, identifying benefits, challenges, and future research directions. Valuable overview provided	AI offers benefits in integrated rice-fish farming: improved water quality, increased crop yields, and reduced pest damage.	Study limitations: English-only research, small sample size, region-specific challenges not considered, and ethical implications not addressed.
2	Artificial Intelligence Chatbots for agricultural Applications	2020	Data collected from various sources, analyzed using content and thematic analysis. AI chatbots offer personalized advice, learn from interactions, but challenges exist: better data and user-friendly design needed. Future research should address these for agricultural revolution.	AI chatbots benefit agriculture with personalized advice, natural language interaction, and learning. Challenges include data quality and user-friendliness. Future focus: user-friendly design and improved data analysis.	Limited scope, no risks discussed. Valuable summary, potential benefits highlighted. Outdated info, small study selection. Limited scope, no risks discussed. Valuable summary, potential benefits highlighted. Outdated info, small study selection.

3	Machine Learning Applications for Precision Agriculture	2020	Conducted systematic review of ML applications in agriculture, focusing on soil parameters prediction, crop yield, disease/weed detection, and intelligent irrigation/harvesting techniques.	ML applications in agriculture enhance soil parameter prediction, crop yield, disease/weed detection, intelligent irrigation, and livestock production.	Limited to reviewed studies, may not cover all ML applications, data availability, and variations in real-world conditions affecting generalizability.
4	Development of Artificial Intelligence-based chatbot for smart aquafarm practices	2022	Developed AquaProFAN to understand aquafarmers' needs. Explored chatbot feasibility. Created Aqua Gent chatbot, analyzed its efficacy, and identified benefits.	Aqua Gent chatbot outperformed other software for informational requests, user-friendly, time-saving, and promising for aquaculture improvement.	Small sample, only tested informational requests, controlled environment. Cost, impact on human aquafarmers, and malicious use not addressed. Future research needed.
5	Chatbots using ML Algorithms in Agricultural Domain	2022	Review existing Agri QA systems, identify key requirements, suggest improvements, conduct surveys, develop prototype chatbot.	Identified ML techniques used in Agri QA, key requirements for effective chatbot, usability suggestions, and developed a prototype.	Limited scope due to short character limit, no specific data or research cited, knowledge up to September 2021, and inability to access current information beyond that date.
6	Farmer-Bot: An Interactive Bot for Farmers	2022	Use KCC dataset, build NLP model for semantic similarity of past queries by farmers, create WhatsApp chatbot with RASA for automatic future query responses.	Developed WhatsApp-based chat-bot using KCC dataset, NLP model for semantic similarity. Enabled automatic responses to farmers' queries, improving agricultural information access.	Reliability of KCC dataset for diverse queries, potential biases in representative data, challenges in accurately addressing nuanced queries, language barriers, and limitations of NLP model affecting response accuracy.
7	Interactive Agricultural Chatbot Based on Deep Learning	2022	Develop an intelligent chatbot using NLP and machine learning algorithms. Implement grammatical recognition, keyword matching, and classification for user queries and responses.	Developed an intelligent chatbot using NLP and ML. Recognizes grammatical errors, matches keywords, and provides nontextual responses for easy farmer communication.	Chatbot's accuracy may vary with complex queries, potential difficulty in recognizing regional dialects, reliance on existing knowledge base, and user's internet connectivity for real-time responses.

8	Artificial intelligence solutions enabling sustainable agriculture using chatbot	2022	Conducted systematic bibliometric analysis of 465 articles and reviews from 2000–2021 on AI in sustainable agriculture. Used VOS viewer and Biblioshiny software for visualization and analysis	Significant increase in academic works on AI in sustainable agriculture since 2018. China, USA, India, Iran, and France top contributors. Multi-disciplinary collaborations observed.	Limitations: Limited to articles from 2000-2021, might miss recent developments. Geographical focus may neglect other countries' contributions.
9	Artificial intelligence in agriculture, applications, benefits and challenges	2022	Analyzed agricultural challenges and proposed solutions, focusing on artificial intelligence-based architectures to enhance crop yields, reduce resource usage, and ensure sustainability.	Artificial intelligence-based solutions improve crop yields, reduce resource usage, enhance sustainability, and ensure increased food production.	May require substantial data for AI accuracy, implementation challenges in diverse agricultural settings, and potential economic barriers.
10	Artificial Intelligent Farmer: A Chatbot-Based Smart Agriculture System	2022	Utilize IoT for continuous agricultural field monitoring via cameras and sensors. Seek expert advice through a pre-programmed chatbot.	Utilizing IoT for continuous field monitoring and expert advice via chatbot enhances agricultural productivity and addresses farming challenges.	Dependence on reliable internet connectivity, camera and sensor maintenance, and potential cost constraints for widespread implementation.
11	Computational Intelligence Chatbot of Machine and Artificial Intelligence Learning for the Expansion of Agriculture's Manufacturing Sector	2023	Conduct literature review on AI in agriculture, analyze case studies, interview experts. Develop report on current state and future prospects. Rigorous, repeatable, and context-relevant.	AI applications identified in agriculture, benefits and challenges discussed. Case studies highlighted experiences of AI use. Expert insights on future prospects obtained. Report created for stakeholders' awareness.	Limited scope due to the absence of specific data, potential bias in case studies, expertise of interviewees, and reliance on existing literature. Incomplete representation of the entire agricultural industry.
12	A Machine Learning-Based Mobile Chatbot for Crop Farmers	2023	Collect agricultural data, create ontology, train chatbot using hybrid machine approach, deploy on mobile platform. Validate and evaluate for effectiveness.	Developed an ontology-based chatbot for Akwa Ibom farmers. Mobile platform deployment, effective in understanding natural language queries, and providing relevant answers.	Potential biases in data collection from limited sources, accuracy and coverage of ontology might be constrained, chatbot's performance in handling complex queries may need further refinement.
13	The Advantages and Limitations of Using Chatbot to Enhance Technological Research	2023	Evaluate ChatGPT 4.0 capabilities, limitations, and weaknesses. Develop fact-checking strategies for high-quality responses. Discuss implications and optimal research applications.	ChatGPT 4.0 evaluated for capabilities and limitations. Factchecking strategies proposed for high-quality responses. Implications and research applications discussed.	Limited scope, lack of specific data on evaluation outcomes, potential bias in research focus, and inadequate details on fact-checking strategies.

14	An Artificial Intelligence-based Recommendation System using Machine Learning	2023	Utilized AI system with machine learning algorithms for precision agriculture. Used Kaggle dataset, SMOTE data balancing, and optimization techniques. Cat Boosting (CBoost) performed best.	AI-based precision agriculture improved crop harvest quality and accuracy. Cat Boosting (CBoost) achieved high accuracy (99.51) in classification.	Limited to specific dataset from Kaggle, may not represent all environmental conditions, generalizability to other regions uncertain.
15	Artificial Intelligent Former: A Chatbot-Based Smart Agriculture System	2023	Develop "GreenWorkLine" website to educate and assist farmers in effective farming, recommending crops based on weather, soil, and water conditions to enhance sales.	"GreenWorkLine" website developed to educate and assist farmers, offering crop recommendations based on weather, soil, and water conditions to increase sales and improve farming practices.	Relies on accurate weather, soil, and water data, may not account for all regional variations, access to technology and internet may be limited for some farmers.

## 2. OVERVIEW OF INTEGRATED FARMING SYSTEM

### 2.1. Definition and Explanation

Rice-fish farming, also known as integrated rice-fish farming, is a farming system that involves the combined cultivation of rice plants and the rearing of fish in the same ecosystem. It is a form of agroecosystem where rice fields and fishponds or water bodies are integrated to create a symbiotic relationship between the two components. In rice-fish farming, the rice field serves as the main crop production area, while the fishpond or water body acts as a secondary component for fish rearing. The fish are stocked in the waterlogged or shallow portions of the rice field, where they coexist with the rice plants throughout their growth cycle. The specific methods and techniques employed may vary depending on the local conditions and cultural practices. Commonly used fish species in rice-fish farming include carp, tilapia, catfish, and other compatible species. The interaction between rice and fish in this farming system is mutually beneficial. The rice plants provide shade, shelter, and food sources for the fish, while the fish contribute to pest control by consuming insects, weeds, and larvae that may harm the rice crop. Additionally, fish excreta serve as a source of natural fertilization for the rice plants, enhancing soil fertility and nutrient cycling.

Rice-fish farming has several advantages, including increased farm productivity, efficient resource utilization, and reduced reliance on external inputs. It promotes ecological balance, biodiversity conservation, and sustainable agriculture practices. Furthermore, it can provide farmers with additional income streams through fish sales, improving overall farm profitability. The specific design and management of rice-fish farming systems can vary based on factors such as climate, water availability, farm size, and local traditions. The integration of rice and fish in a single farming system showcases an innovative approach to achieve sustainable agriculture and aquaculture, optimizing the use of land, water, and natural resources.

The interaction between rice and fish in this farming system is mutually beneficial. The rice plants provide shade, shelter, and food sources for the fish, while the fish contribute to pest control by consuming insects, weeds, and larvae that may harm the rice crop. Additionally, fish excreta serve as a source of natural fertilization for the rice plants, enhancing soil fertility and nutrient cycling. Rice-fish farming has several advantages, including increased farm productivity, efficient resource utilization, and reduced reliance on external inputs. It promotes ecological balance, biodiversity conservation, and sustainable agriculture practices. Furthermore, it can provide farmers with additional income streams through fish sales, improving overall farm profitability.

## 2.2. History

The practice of integrated rice-fish farming has a long history and can be traced back to ancient times in certain regions. While the specific origins may be challenging to pinpoint, integrated rice-fish farming has been documented in different parts of the world, particularly in Asia. In Asia, where rice cultivation is prevalent, integrated rice-fish farming has been practiced for centuries. It is believed that the integration of fish and rice in agricultural systems originated as a traditional farming practice in countries such as China, Vietnam, Bangladesh, and Indonesia. Historically, rice-fish farming was driven by practical considerations and the need to optimize resource utilization. Farmers recognized the complementary relationship between rice and fish, as the fish helped control pests and weeds in the rice fields while benefiting from the natural food sources and shelter provided by the rice plants. In China, evidence of integrated rice-fish farming dates back thousands of years. Ancient Chinese agricultural texts, such as the "Book of Odes" and the "Book of Rites," contain references to rice-fish culture.

Traditional Chinese farming systems, such as the famous "Duck-Fish-Rice" integrated farming system in the Pearl River Delta, incorporated the rearing of ducks, fish, and rice in a symbiotic manner. In Southeast Asia, historical records suggest that rice-fish farming was practiced as early as the 8th century. Ancient texts from the region describe the use of fish to control pests in rice fields and the intentional coexistence of rice and fish in interconnected systems. Over time, the knowledge and practices of integrated rice-fish farming were passed down through generations, often within farming communities.

These systems were refined and adapted to local conditions, leading to the development of diverse methods and techniques. In recent decades, as sustainable agriculture and aquaculture gained prominence, there has been a renewed interest in integrated rice-fish farming. Researchers and farmers have studied and experimented with different approaches to enhance productivity, optimize fish stocking densities, improve water and nutrient management, and adapt the systems to modern agricultural practices. Today, integrated rice-fish farming continues to be practiced in various parts of the world, driven by the desire for sustainable and efficient food production. It represents a combination of traditional wisdom and modern knowledge, promoting the integration of ecological principles into agricultural systems. As integrated rice-fish farming continued to evolve, it spread to other regions outside of Asia. In ancient Egypt, historical evidence indicates the practice of integrated rice-fish farming in the Nile River delta. The Egyptians cultivated rice in flooded fields, creating an ideal environment for fish to thrive alongside the rice crops. This practice demonstrated the early recognition of the mutual benefits of combining rice and fish in agricultural systems.

Today, integrated rice-fish farming is being actively promoted as a climate-smart and sustainable farming practice, aligning with the principles of agroecology and ecological farming. The revival of interest in traditional ecological knowledge, coupled with modern scientific advancements, has led to the development of innovative techniques and technologies to optimize the productivity and efficiency of integrated rice-fish farming. As the world faces new challenges, such as climate change, water scarcity, and the depletion of natural resources, integrated ricefish farming offers a promising avenue to achieve food security while conserving the environment. By embracing the wisdom of ancient practices and integrating it with modern knowledge, the farming communities of today can continue to reap the benefits of this age-old, yet ever-relevant, agricultural approach. Over time, the knowledge and practices of integrated rice-fish farming were passed down through generations, often within farming communities. These systems were refined and adapted to local conditions, leading to the development of diverse methods and techniques. In recent decades, as sustainable agriculture and aquaculture gained prominence, there has been a renewed interest in integrated rice-fish farming. Researchers and farmers have studied and experimented with different approaches to enhance productivity, optimize fish stocking densities, improve water and nutrient management, and adapt the systems to modern agricultural practices.

### 2.3. Key Components

Component	Description
Natural language processing	NLP enables chatbot to comprehend farmers' language, providing intuitive interactions and seamless communication. Empowers farmers with real-time information for integrated rice-fish farming, optimizing engagement and decision-making in agriculture.
Machine learning algorithms	Through machine learning, the chatbot learns from user interactions and data, providing tailored responses for individual farmers. This personalized support enhances integrated rice-fish farming practices, empowering farmers to make informed decisions. With continuous learning, the chatbot evolves, improving accuracy and relevance, optimizing agricultural approaches, and promoting sustainability within rice-fish ecosystems.
Crop cultivation techniques	The chatbot offers guidance on crop cultivation techniques like planting, fertilizing, and harvesting. It assists farmers in optimizing their practices for integrated ricefish farming, leading to improved productivity and efficiency.
Fish species selection	The chatbot aids farmers in selecting appropriate fish species for their ponds and climate, considering factors like water conditions and environmental suitability. This guidance optimizes fish rearing in integrated rice-fish farming systems, promoting successful outcomes and sustainable practices.
Water management	The chatbot offers valuable advice on water management, encompassing pond depth, water quality, and flow. By providing tailored recommendations, it empowers farmers to optimize water resources for integrated rice-fish farming, enhancing productivity and environmental sustainability.
Pest and disease control	The chatbot assists farmers in identifying and controlling pests and diseases that may impact crops and fish. Through timely guidance, it helps mitigate risks, minimize losses, and foster healthier and more resilient integrated rice-fish farming systems.

### 3. Proposed system

The proposed system is the view of the conversation of the user and the chatbot. The overall stages of the chatbot. It will give the responses for the user.

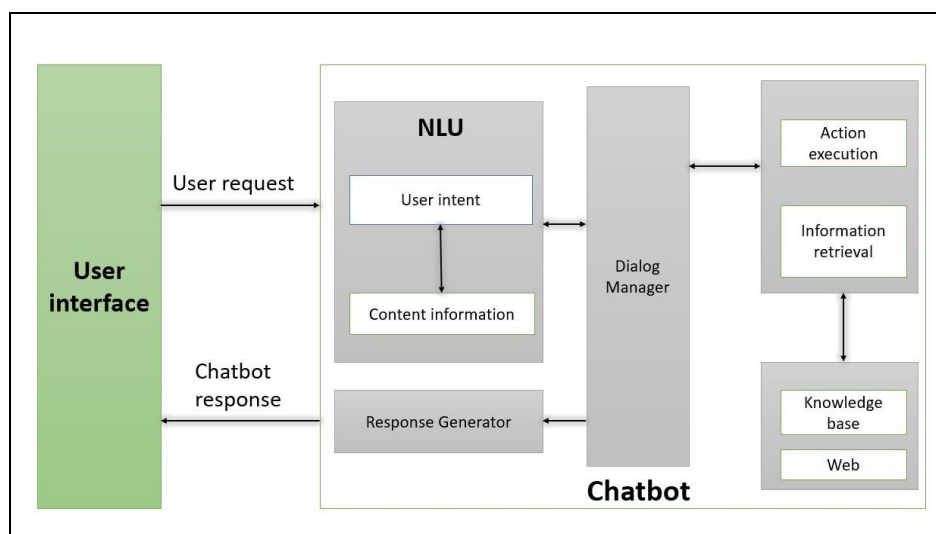


Fig1: Proposed System

### **3.1. User Interface (UI):**

Role: The User Interface is the component through which users interact with the chatbot. It serves as a communication bridge between the user and the chatbot. Details: Users can input their questions, requests, or commands through the UI, which can take various forms such as web applications, mobile apps, voice assistants, or messaging platforms. The UI presents the chatbot's responses to users in a user-friendly manner.

### **3.2. Natural Language Understanding (NLU):**

Role: NLU is responsible for processing and interpreting user input in natural language. It breaks down the input into its constituent parts, such as words, phrases, and entities, and attempts to understand the user's intent. Details: NLU uses techniques like tokenization, part-of-speech tagging, named entity recognition, and intent recognition to extract relevant information from user messages. It plays a crucial role in making sense of user queries and facilitating effective communication with the chatbot.

### **3.3. Dialogue Manager (DM):**

Role: The Dialogue Manager determines how the chatbot should respond to user inputs based on the identified intent, conversation history, and the chatbot's predefined logic. Details: DM acts as the decision-making component, orchestrating the conversation flow. It considers the current context, any previous interactions in the conversation, and the chatbot's internal logic or scripts to determine the appropriate response strategy. DM's role is to ensure coherent and contextually relevant interactions with the user.

### **3.4. Knowledge Base (KB):**

Role: The Knowledge Base is a repository of information that the chatbot can access to provide accurate and informative responses. Details: KB stores a wide range of data, including facts, rules, procedures, product details, historical information, and any other relevant information required by the chatbot. It serves as the reference point for the chatbot to retrieve information needed to answer user queries accurately.

### **3.5. Response Generator (RG):**

Role: The Response Generator is responsible for crafting the actual responses that the chatbot delivers to the user. It combines the output from the DM with information from the KB to generate coherent and contextually appropriate responses. Details: RG takes the decision made by the DM and uses it as a blueprint to formulate a response. It may involve assembling text fragments, inserting dynamic data from the KB.

## **4. CHALLENGES IN INTEGRATION OF CHATBOT AND SENSORS**

The integration of chatbot and sensors plays a major role in the field. The below are the roles played in this.

### **4.1. Data collection and quality:**

Obtaining high-quality and relevant data on rice-fish farming practices can be challenging, limiting the chatbot's ability to provide accurate and personalized recommendations.

### **4.2. Language and Regional Variation:**

Language and regional variations present significant challenges for the AI chatbot in integrated rice-fish farming. Farmers across different regions may use diverse languages and terminologies to describe farming practices, requiring the chatbot to be multilingual and adaptable. Additionally, regional contexts influence farming techniques, climate, and cultural practices, necessitating context-aware responses. Ensuring accurate and relevant guidance in various



regional contexts demands extensive training data and continuous updates to enhance the chatbot's language comprehension and cultural sensitivity.

### 4.3. User acceptance and Trust:

User acceptance and trust are essential for the success of AI chatbots for integrated rice-fish farming. Farmers may be hesitant to rely on AI technology due to unfamiliarity or lack of trust, so it is important to make sure that the chatbot is easy to use and understand, and that it provides accurate and reliable information. Additionally, the chatbot should be transparent about its limitations and how it works, in order to build trust with farmers.

### 4.4. Connectivity and Access:

Connectivity and access challenges in rural areas affect AI chatbot usage in integrated rice-fish farming. Solutions include offline chatbots, free data plans, and multi-platform availability to enhance accessibility, empowering farmers for improved yields and productivity.

### 4.5. Ethical Considerations:

The use of AI in agriculture raises ethical concerns. Privacy issues arise with data collection. Biases in AI algorithms can impact decision-making.

## 5. STATIC CHATBOT CODE & RESPONSES

### 5.1. Chatbot Code in Python

```
class RohithChatbot:
    def __init__(self):
        self.responses = {
            'Hi': 'Hello! \n',
            'How is my farm?': 'Yeah, its good!\n',
            'What is the temperature in farm?': '39-degree Celsius\n',
            'What is the humidity in farm?': '28-degree
            Celsius\n',
            'Does the fish\textquotesingle s condition is good?': 'yes it seems
            good\n',
            'How many fishes are alive?': '59 fishes are alive \n',
            'Does any different species detected?': 'yeah 10 dragonflies are
            detected\n',
            'What is the turbidity level?': '10 NTUs\n',
            'How much is the water level of the farm?': '10m\n
            ',
            'Does the crop condition is good?': 'Yeah it\'s good!\n',
            'What is the soil condition?': 'Its good\n',
            'How much water is required for the farm?': '150L\n',
            'bye': 'thanks and come back soon.\n',
        }

    def generate_response(self, message): message =
        message.lower() if message in self.responses:
            return self.responses[message]
        else:
            return self.responses['bye']
```

Fig2: Rohith Chatbot Code in Python

## 5.2. RESULTS AND DISCUSSION:

In this section, present the outcomes of the interaction between the farmer and the chatbot. Highlight the chatbot's capability to answer questions about the farm, including, fish condition, water level, soil condition, dragonflies, water requirements, turbidity level, and crop condition.

```

===== RESTART: C:\Users\dpriy\OneDrive
User: hi
Chatbot: Hello!

User: how is my farm?
Chatbot: Yeah, its good!

User: does the crop condition is good
Chatbot: Yeah it's good!

User: what is the humidity in farm
Chatbot: 22-degree Celsius

User: what is the temperature in farm
Chatbot: 11-degree Celsius

User: how many fishes are alive
Chatbot: 51 fishes are alive

User: what is the turbidity level
Chatbot: 14 NTUs

User: how much water is required for the farm
Chatbot: 150L

User: what is the soil condition
Chatbot: Its good

User: how much is the water level of the farm
Chatbot: 10m

User: does any different species detected
Chatbot: yeah 10 dragonflies are detected

User: bye
Chatbot: Thanks and come back soon.

```

Fig.3. Responses of chatbot

- 1) Utility of the Chatbot: Discuss how the chatbot serves as a valuable tool for farmers, enabling them to remotely monitor and gather essential information about their farms. Highlight its convenience and potential benefits for farmers who may not always be physically present on the farm.
- 2) Farm Monitoring: Explain how the chatbot's ability to answer a wide range of farm-related questions enhances the farmer's ability to monitor the farm's condition comprehensively. This can lead to more informed decision-making and timely interventions.
- 3) Technology in Agriculture: Reflect on how this chatbot represents an example of technology's role in modern agriculture. Discuss how such technology can contribute to increased efficiency, sustainability, and productivity in farming practices.
- 4) Limitations and Future Improvements: Acknowledge any limitations of the chatbot and suggest potential areas for improvement. Consider factors like the chatbot's accuracy, response time, and adaptability to different farm setups.
- 5) Farmers' Perspectives: If possible, discuss the farmers' feedback or experiences with using the chatbot. Their insights can provide valuable qualitative data on its practical utility and user-friendliness.

## 6. CONCLUSIONS

Calibration and maintenance of sensors must be done with great care if chatbots are to successfully integrate them. Difficulties like inconsistent standards and sensor drift require automated and standardised processes to reduce errors and maximise resource usage. User training encourages comprehension of the importance of the processes, while documentation guarantees transparency and helps with quality control. Finding equilibrium between expenses and advantages is essential for sustained prosperity. Sustaining the precision and consistency of sensor data requires a methodical and proactive approach, which in turn improves the efficacy of chatbot applications across a range of industries.

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### *Authors' Biography*

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#### **Dr. T. M. Usha**

*Dr. T. M. Usha* is a Ph.D. candidate in the Faculty of Information and Communication Engineering at Anna University, Chennai, Tamil Nadu. She is currently a professor in the Department of Computer Science and Engineering (Internet of Things) at Ramachandra College of Engineering, Eluru. She is leading an Indian Government-Funded Project from the All-India Council for Technical Education (AICTE), TiH-IoT, IIT Bombay (Department of Science & Technology), and the Ministry of Micro, Small & Medium Enterprises (MSME). With over 22 years of experience, she has worked as a Research Project Coordinator in research and development (R&D) cells within various educational institutions and software industries. She possesses strong skills in the Internet of Things, Data Science, Machine Learning, Pattern Recognition, Computer Vision and Artificial Intelligence



#### **R. Rohith Kumar**

*R. Rohith Kumar*, software maestro from JNTU, skilled in C++, Python, Java. Visionary at TIH-IOT Chanakya, lauded by DST India and Yashoda Hospital for Disease Prediction. Certified in C, Python, ML, Java, with a decade's expertise for impactful projects.



**Dedipya Edupalli**

*Dedipya Edupalli*, tech enthusiast from Jawaharlal Nehru Technological University. Proficient in Python, C, Java, and ML. Visionary intern at IIT Bombay's Chanakya Fellowship, recognized for integrated farming prowess. Certified in coding and ML, poised for impactful contributions in the tech industry.

**Hari Lakshmi A.S**

*Hari Lakshmi A.S* is a B. Tech. candidate at Jawaharlal Nehru Technological University, Kakinada. She possesses professional experience as an analyst in the Environment, Social, and Governance (ESG) domain, along with a background as a Machine Learning Engineer.

**D.VVK Sudhishna**

*D.VVK Sudhishna* immersed in her B. Tech studies, specializes in IoT at Jawaharlal Nehru Technological University, Kakinada. she also possesses knowledge of various programming languages. Additionally, she has gained practical experience through internships in web development and cloud computing.

**S. V. D. S. Raghuram Akula**

S. V. D. S. Raghuram Akula, Computer Science student of JNTUK. With the knowledge of few computer languages and IoT. Worked on some of the projects in the domain of web development and android app development for various companies as an intern.

