International Journal of Scientific Research & Engineering Trends
Volume 8, Issue 4, July-Aug-2022, ISSN (Online): 2395-566X

Smart Agriculture Using IOT and Machine Learning

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Abstract- Agriculture plays a very important role in both fields, such as food necessity for human beings and providing necessary stocks for many food industries, and it is one of the most effective and the backbone of India. The future of innovation in creating farming methods is moderately reinforcing the crop yield to make it more commercial and reduce irrigation debris. In this research paper, we are pleased to introduce our prototype for Smart Agriculture using IoT and Machine Learning. Firstly, we will construct a greenhouse and then test different kinds of crops grown inside. By using IoT devices, we will collect various datasets consisting of moisture, temperature, and humidity, which are the three most vital parameters that are required in any agriculture field. This system comprises temperature, humidity, and moisture sensors, installed in the greenhouse, and sends data through an Arduino Board, developing an IoT device with the cloud. Machine learning algorithms are applied to the dataset which is collected from the greenhouse field to predict results proficiently.

Keywords- IoT, Machine learning, plants.

I. INTRODUCTION

Agriculture plays a very important role; it is one of the main sources of food and a majority of people in India are counting on agriculture as their major source of income.

The development and utilization of the Smart Agriculture structure are based on IoT and Machine Learning is advanced in the field of agriculture division by not only boosting the crop production but also making it cost effectual. There is no dubiety that the government needs to invest in the agriculture sector for it to bloom.

The effects of desperate changes in climatic infirmity have seen crop yield drop by more than a sector. There needs to be a focus on the accomplishment of smart automation in the field of agriculture to yield quality and mass production of crops. The collaboration of IoT and Machine Learning can surely, help in decrement of cost and also help grow the scale of manufacturing through the collecting of time sequence data or the information from sensors. There are certain elements, which play a major role in the production of crops. Such as humidity, temperature and soil moisture.

II. LITERATURE SURVEY

AI and IoT Based Monitoring System for Increasing the Yield in Crop Production:
Richa Singh, Sarthak Srivastava, Rajan Mishra AI and (0) IoT. The research is performed on a marigold plant to detect the most suitable conditions for the plant. The effect of physical conditions like humidity, temperature, soil temperature and moisture and light intensity on the plant growth, is monitored using IoT based monitoring system (ICE3 - February 2020)

IoT based Smart Agriculture using Machine Learning:
Kasara Sai Pratyush Reddy, Y Mohana Roopa, Kovvada Rajeev L N, Narra Sai Nandan IoT and Machine Learning the system is programmed to be trained from the given dataset using all the sensed data from the soil moisture, temperature and humidity. By applying the decision tree learning algorithm to the real-time data its processes and generates an output yes/no and sends the decision to (IEEE – 04 September 2020) the farmer through an email. Using this decision, a farmer can decide to water the crop only when required.

Smart Agriculture Using IoT and Machine Learning:
Sameer M, Mittal B, Sarvesh S, Sagar D IoT and Machine Learning The real-time readings coming from the sensors along with the application of Machine Learning Algorithms will not only help farmers make informed decisions on which crop to grow in a particular region but also recommend fertilizers based on various factors like soil condition, climatic conditions (1) etc. In addition, from the various machine-learning algorithms implemented, XGBoost seems to give the best results with 31% accuracy on the recommendations (IRJET - 04 April 2021)

IoT and Machine LearningApproach for Automation of Anneketh Vij, Singh Vijendra, IoT and Machine Learning:
It provides a sustainable and computationally efficient approach based on IoT based establishing (ICCIDS – 2019) Farm Irrigation System Abhishek, Shivam, Aashima Bassi, Arushi Sharma a proper distributed network contributes to the accuracy of the predictions made by SVR, and Random Forrest Sensor node inter-connectivity will help monitor the complete field thoroughly. To implement a system which would be mobile and can help in every stage of farming. (2)

Smart Agriculture Using IoT and Machine Learning: Sumiksha Shetty & A. B. Smitha IoT and Machine Learning In this paper, the assistance of IoT and machine learning in farming, can expand the productivity (3)

Smart Agriculture Using IoT and Machine Learning: Sumiksha Shetty & A. B. of yield Different climate parameters are taken into thought from which the best reasonable yield is grown is predicted by a supervised (4) learning algorithm, decision tree, utilized in regions like sickness recognition, crop discovery, irrigation system, soil conditions and also the product quality and market analysis.

III. METHODOLOGY

In this Project, the most important and implemented concept is the Internet of Things (IoT). There will be different types of devices that will measure different variables of the surroundings like temperature, humidity, soil moisture, UV radiation, etc

Then the data received from these devices or sensors will be then be transferred to the Thinkspeak. com cloud Database, which displays the data given from the sensors in the form of a graph. After this, the data collected from the sensors will be stored in a CVS Configuration File and will be used to implement Machine Learning Algorithms which will predict the growth of the plant-based on the surroundings. On the other hand, there will be an option to connect the device to a phone application with the help of a Bluetooth module. The data will then be pushed to the database server using the phone. (6) The major part of the project will be a hardware device that constitutes of different kinds of sensors such as Soil Moisture Sensor (EK1361), Humidity and Temperature Sensor (DHT22), and UV Radiation Sensor (ML-8511).

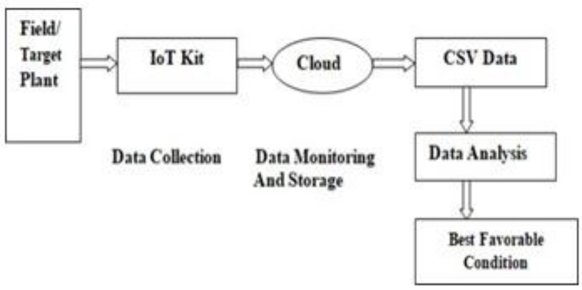

Fig 1. Workflow Diagram of Smart Agriculture using IoT and Machine Learning.

The device collects the attributes of the surrounding (soil moisture, temperature, radiation intensity) independently and processes. The WIFI Module ESP8266 will then send the received data immediately to the Think speak database. And after Implementing Different Machine Learning Algorithms we can predict the Yield or growth of the plant. And also, from the mobile application, we can view the data received from the sensors. The received data will be utilized to process requirements that a farmer needs to take care of, for maximum yield of the crops.

IV. PROPOSED METHODOLOGY

The major part of the proposed methodology will be a hardware device that constitutes of different kinds of sensors such as Soil Moisture Sensor (EK1361), Humidity and Temperature Sensor (DHT22), pH Sensor (SKU: SEN0161) and UV Radiation Sensor (ML-8511). (8) The device collects the attributes of the surrounding (soil moisture, temperature, pH, radiation intensity) independently and processes them with the help of its microcontroller ATMega328p.2 The microcontroller will then send the received data immediately to the AWS S3 database and open source free think speak cloud. In the proposed methodology, the main concept implemented is the Internet of Things (IoT). There will be a low-level hardware device that will measure different variables of the surroundings like temperature, humidity, soil moisture, UV radiation, etc. (9)

The measured values will then be transferred to the AWS S3 database or Thinkspeak cloud database, which will later be pulled back to a mobile application for further processing. On the other hand, there will be an option to connect the device to a phone application with the help of an API key in the Thinkspeak cloud database. The data will then be pushed to the database server using the phone. (6) The major part of the proposed methodology will be a hardware device that constitutes of different kinds of sensors such as Soil Moisture Sensor (EK1361), Humidity and Temperature Sensor (DHT22), and UV Radiation Sensor (ML-8511). The device collects the attributes of the surrounding (soil moisture, temperature, radiation intensity) independently and processes them with the help of its microcontrollerATMega328p.

The microcontroller will then send the received data immediately to the AWS S3 database or think to speak cloud database. On the other hand, a Bluetooth module will be connected to the microcontroller so that the (6) user gets to connect to the device locally, and send the data manually through a Mobile application.

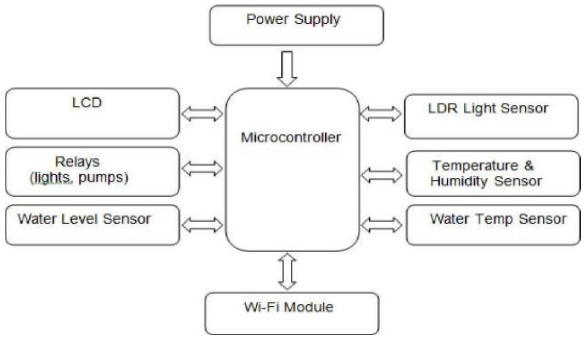

Fig 2. Block diagram for IoT Connections.

International Journal of Scientific Research & Engineering Trends
Volume 8, Issue 4, July-Aug-2022, ISSN (Online): 2395-566X

The received data will be utilized to process requirements that a farmer needs to take care of, for maximum yield of the crops. To interface the user with the device's data. The data received from the hardware device will be analyzed using different machine learning algorithms and researched agricultural datasets in the past. According to the results from different backend machine learning algorithms, a suggestion template will be developed. so that the farmer knows what to do next. The main challenge will be to collect different agricultural datasets that will be used to analyse the data received from the hardware device. (12) The mobile application will be fully focused on the data visualization and helpful suggestions of each user.

Fig 3. Smart agriculture using IoT with Greenhouse protocol.

V. FIGURES AND TABLES

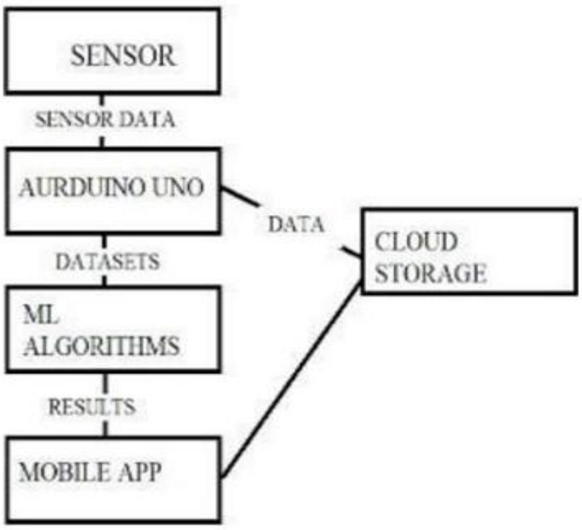

Fig 4. Interconnection of Systems and Dataflow.

Fig 5. Graphical Representation of Sensors Data.

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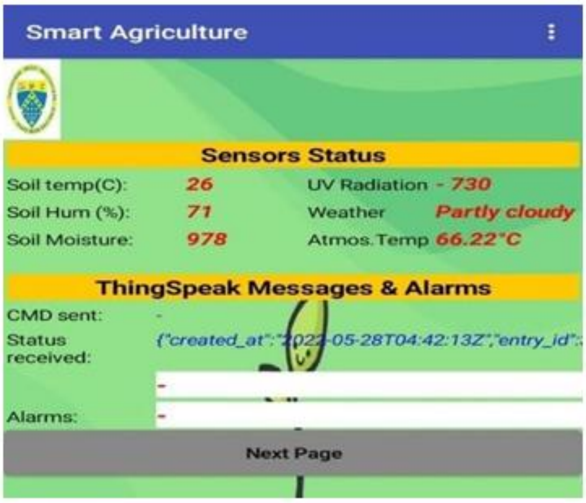
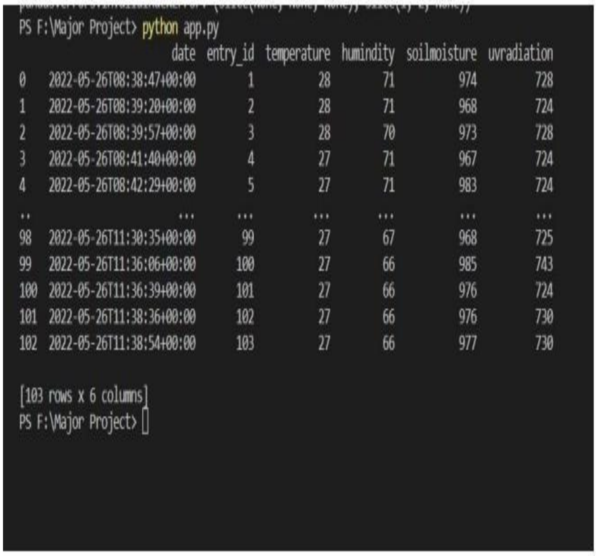


Fig 6. Real Time Sensors data in Mobile Application.



```
PS F:\Major Project> python app.py
                         date  entry_id  temperature  humindity  soilmoisture  uvradiation
0   2022-05-26T08:38:47+00:00         1           28         71           974          728
1   2022-05-26T08:39:20+00:00         2           28         71           968          724
2   2022-05-26T08:39:57+00:00         3           28         70           973          728
3   2022-05-26T08:41:40+00:00         4           27         71           967          724
4   2022-05-26T08:42:29+00:00         5           27         71           983          724
..                        ...       ...          ...        ...           ...          ...
98  2022-05-26T11:30:35+00:00        99           27         67           968          725
99  2022-05-26T11:36:06+00:00       100           27         66           985          743
100 2022-05-26T11:36:39+00:00       101           27         66           976          724
101 2022-05-26T11:38:36+00:00       102           27         66           976          730
102 2022-05-26T11:38:54+00:00       103           27         66           977          730

[103 rows x 6 columns]
PS F:\Major Project> 
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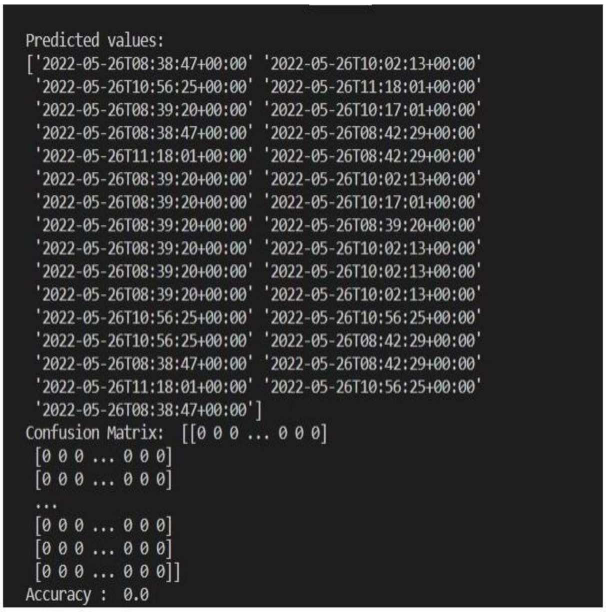

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Predicted values:
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 '2022-05-26T10:56:25+00:00' '2022-05-26T11:18:01+00:00'
 '2022-05-26T08:39:20+00:00' '2022-05-26T10:17:01+00:00'
 '2022-05-26T08:38:47+00:00' '2022-05-26T08:42:29+00:00'
 '2022-05-26T11:18:01+00:00' '2022-05-26T08:42:29+00:00'
 '2022-05-26T08:39:20+00:00' '2022-05-26T10:02:13+00:00'
 '2022-05-26T08:39:20+00:00' '2022-05-26T10:17:01+00:00'
 '2022-05-26T08:39:20+00:00' '2022-05-26T08:39:20+00:00'
 '2022-05-26T08:39:20+00:00' '2022-05-26T10:02:13+00:00'
 '2022-05-26T08:39:20+00:00' '2022-05-26T10:02:13+00:00'
 '2022-05-26T08:39:20+00:00' '2022-05-26T10:02:13+00:00'
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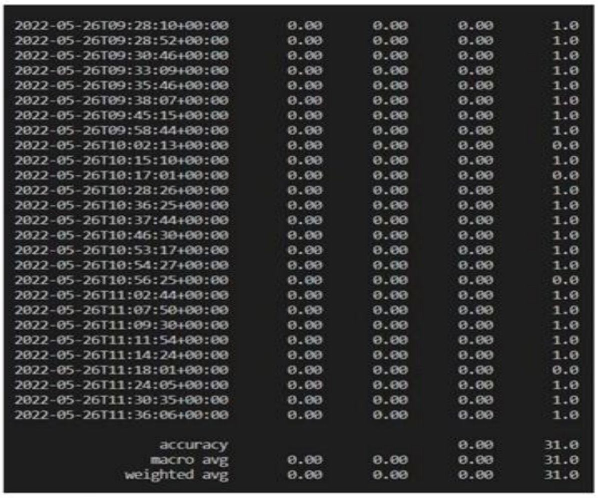
 '2022-05-26T08:38:47+00:00' '2022-05-26T08:42:29+00:00'
 '2022-05-26T11:18:01+00:00' '2022-05-26T10:56:25+00:00'
 '2022-05-26T08:38:47+00:00']
Confusion Matrix:  [[0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]
 ...
 [0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]
 [0 0 0 ... 0 0 0]]
Accuracy :  0.0
```



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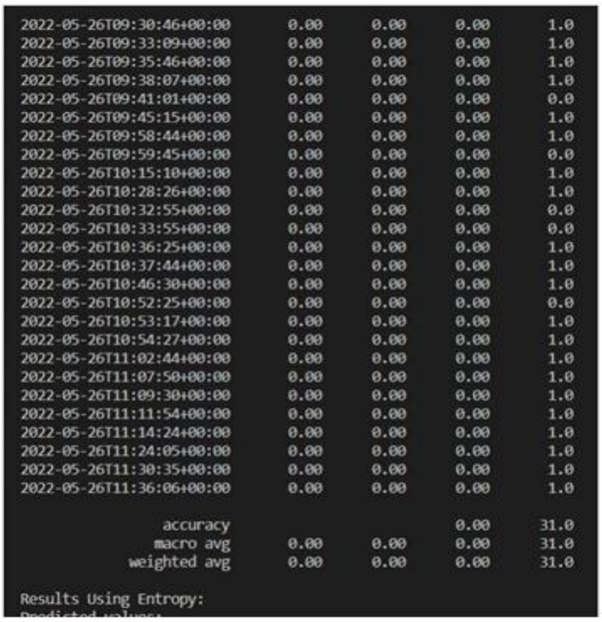
2022-05-26T09:28:52+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:30:46+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:33:09+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:35:46+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:38:07+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:45:15+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:58:44+00:00       0.00      0.00      0.00       1.0
2022-05-26T10:02:13+00:00       0.00      0.00      0.00       0.0
2022-05-26T10:15:10+00:00       0.00      0.00      0.00       1.0
2022-05-26T10:17:01+00:00       0.00      0.00      0.00       0.0
2022-05-26T10:28:26+00:00       0.00      0.00      0.00       1.0
2022-05-26T10:36:25+00:00       0.00      0.00      0.00       1.0
2022-05-26T10:37:44+00:00       0.00      0.00      0.00       1.0
2022-05-26T10:46:30+00:00       0.00      0.00      0.00       1.0
2022-05-26T10:53:17+00:00       0.00      0.00      0.00       1.0
2022-05-26T10:54:27+00:00       0.00      0.00      0.00       1.0
2022-05-26T10:56:25+00:00       0.00      0.00      0.00       0.0
2022-05-26T11:02:44+00:00       0.00      0.00      0.00       1.0
2022-05-26T11:07:50+00:00       0.00      0.00      0.00       1.0
2022-05-26T11:09:30+00:00       0.00      0.00      0.00       1.0
2022-05-26T11:11:54+00:00       0.00      0.00      0.00       1.0
2022-05-26T11:14:24+00:00       0.00      0.00      0.00       1.0
2022-05-26T11:18:01+00:00       0.00      0.00      0.00       0.0
2022-05-26T11:24:05+00:00       0.00      0.00      0.00       1.0
2022-05-26T11:30:35+00:00       0.00      0.00      0.00       1.0
2022-05-26T11:36:06+00:00       0.00      0.00      0.00       1.0

                 accuracy                           0.00      31.0
                macro avg       0.00      0.00      0.00      31.0
             weighted avg       0.00      0.00      0.00      31.0
```



```
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2022-05-26T09:33:09+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:35:46+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:38:07+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:41:01+00:00       0.00      0.00      0.00       0.0
2022-05-26T09:45:15+00:00       0.00      0.00      0.00       1.0
2022-05-26T09:58:44+00:00       0.00      0.00      0.00       1.0
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2022-05-26T10:52:25+00:00       0.00      0.00      0.00       0.0
2022-05-26T10:53:17+00:00       0.00      0.00      0.00       1.0
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2022-05-26T11:36:06+00:00       0.00      0.00      0.00       1.0

                 accuracy                           0.00      31.0
                macro avg       0.00      0.00      0.00      31.0
             weighted avg       0.00      0.00      0.00      31.0

Results Using Entropy:
```

Fig 7. Showing the efficiency of the machine learning algorithm.

VI. EXPERIMENTAL RESULTS

We used different platforms to get crop data with all the above-mentioned attributes and got some datasets from the agricultural college G.K.V.K as well as from other sources (like Kaggle), we have used our monitored data for this existing project to do experiment.

The training dataset used for the training of crop prediction model contains features like nitrogen, potassium, phosphorus, temperature, humidity, and rainfall whereas the fertilizer recommendation model contains features like nitrogen, phosphorus, potassium, pH and soil moisture. Various Machine learning algorithms were applied against the training dataset - Decision Tree, Naive Bayes, Support Vector Machine, Logistic Regression, Random Forest and XGBoost, and were compared based on the model's accuracy.

The user, which is a Farmer, will be able to use our platform to get accurate recommendations regarding which crop to grow based on different features like humidity, pH, and rainfall. Besides that, the user will be able to predict yield based on different features like moisture, nitrogen, phosphorus and potassium.

VII. CONCLUSION

We conclude that the sensors (such as temperature and humidity sensor, Soil moisture sensor, and UV radiation sensor) which will be fixed in the greenhouse are taken as input, through the microcontroller and esp8266 Wi-Fi module and the data received from the sensors will be sent to Thinkspeak cloud. Then this data collected from sensors will be analyzed by a machine learning algorithm (decision tree) by this algorithm using known parameters we can predict the unknown parameter (growth rate of the plant) and the current sensors value will be displayed through application which is created using MIT mobile application software.

VIII. APPENDIX

1. Arduino IDE:
Arduino IDE is a platform which allows to program the Arduino microcontrollers which we discussed in the hardware components. We can code the micro controller according to our application and its syntax is relatively simple. It is an open source and we can use embedded C to program. It's simple to use this IDE as there are readymade code examples. The editor has many features which makes the programming look easy. The programs are known as sketches in this platform. The procedure of using this IDE is selecting the board and writing the appropriate code for it. Once the code is completed, compile and check for errors and then upload code to the microcontroller. Once the code is uploaded the board performs the specified operation.

2. MIT app inventor:
It is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows developers to create application software (apps) for two operating systems (OS): Android, and iOS. It uses a graphical user interface (GUI) very similar to the programming languages Scratch (programming language) and the Star Logo, which allows users to drag and drop visual objects to create an application that can run on Android devices.

3. Decision tree:
Decision trees use multiple algorithms to decide to split a node into two or more sub-nodes. The creation of sub-nodes increases the homogeneity of resultant sub-nodes. In other words, we can say that the purity of the node increases with respect to the target variable.

IX. ACKNOWLEDGMENT

It is a great pleasure for us to acknowledge the assistance and support of many individuals who have been responsible for the successful completion of this project work. First, we take this opportunity to express our sincere gratitude to the School of Engineering & Technology, Dayananda Sagar University for providing us with a great opportunity to pursue our Bachelor's degree in this institution.

We would like to thank Dr. A Srinivas. Dean, School of Engineering & Technology, Dayananda Sagar University for his constant encouragement and expert advice. It is a matter of immense pleasure to express our sincere thanks to Dr. Girisha G S, Department Chairman, Computer Science and Engineering, Dayananda Sagar University, for providing the right academic guidance that made our task possible. We would like to thank our guide Professor Vaidehi Verma, Associate Professor, Dept. of Computer Science and Engineering, Dayananda Sagar University, for sparing her valuable time to extend help in every step of our project work, which paved the way for smooth progress and fruitful culmination of the project.

We would like to thank our Project Coordinator Dr. Meenakshi Malhotra and Dr. Bharanidharan N, and all the staff members of Computer Science and Engineering for their support. We are also grateful to our family and friends who provided us with every requirement throughout the course. We would like to thank one and all who directly or indirectly helped us in the Project work.

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