Smart Agricultural System

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***Abstract* — The project focuses on creating a smart agricultural system which can be used to evolve the current agricultural practices used. We use CISCO packet tracer to create the basic network for data collection of different crop's conditions. Then, we work to create a project that will help the agriculture sector calculate, predict and improve the conditions that govern the particular crop namely N, P, K values of the soil, pH values, temperature, humidity, rainfall levels of the atmosphere around the crop fields. The consideration of these factors is important so that right crop is grown at the right time and at the right place with optimal results. The collection of such a data is a challenging as it requires a huge sensor network distributed over multiple large fields. We focus on the finding the relationship between various environmental factors and various crops (22 unique crops). Relationship thus established is put through a training model for prediction results of the crops. The personalized results and predictions are then sent to the user after performing the model classification via email using Simple Mail Transfer Protocol (SMTP).**

***Keywords* —** *CISCO packet tracer, NPK values, Wireless sensor Networks, Simple Mail Transfer Protocol, model training, model classification, AES, TKIP.*

I. Introduction

Agriculture is a very crucial part of the economy of a country. The sector not only focuses on providing the food sources in bulk but also provides various employment opportunities to the people. The agriculture is very important but it is mostly dependent on the environmental factors of the area and hence it is necessary to regulate these.

By 2050, agriculture is expected to provide food for almost 9.7 billion people worldwide, according to a forecast study. To feed the entire world's population in 2020 alone, an increase in agricultural production of 60% was needed. So it's crucial that we make an effort to effectively optimise the agricultural area. The primary forces behind the digital transformation of agriculture are macroeconomics, shifting consumer tastes, rising technologies, and changing supply chains. These factors show how the issues facing the global agriculture industry may be successfully met by adopting the proper strategy and utilising technology. The current COVID-19 problem has highlighted the agricultural industry's vulnerability and prompted concerns about how to sustainably supply the world's growing food demand in light of the competing negative elements. Once more, efficiency is the key to finding a solution because, more than ever, it allows for greater output with less. Data science and artificial intelligence will revolutionise the sector. Farmers will be equipped with the resources necessary to maximise every acre.

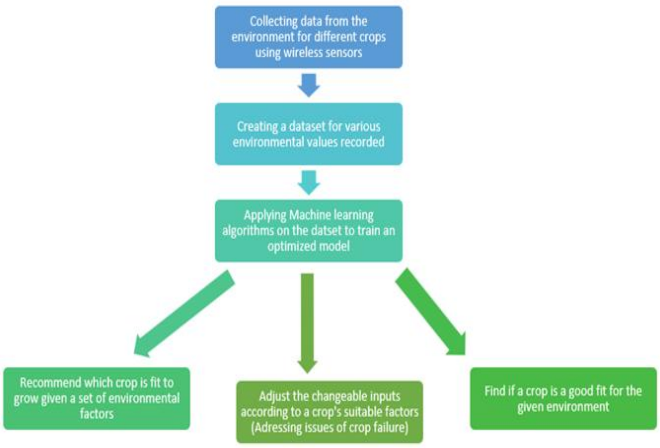


Figure A: Issues the project plans to address

II. Background

Smart agriculture monitoring system is an emerging technology concept where data from several agricultural fields ranging from small to large scale and its surrounding are collected using smart electronic sensors (WSN).

The collected data are analyzed by experts and local farmers to draw short term and long-term conclusion on weather pattern, soil fertility, current quality of crops, amount of water that will be required for next week to a month etc.

We can take smart farming a step further by automating several parts of farming, for example smart irrigation and water management. We can apply predictive algorithms on microcontrollers or SoC to calculate the amount of water and other factors affecting crops that will be required for a particular agriculture field or a specific crop.

A. *Wireless Sensor Networks (WSN)*

A wireless sensor network (WSN) is a network of some tiny embedded devices known as sensors that connect wirelessly using an ad hoc design. These networks comprise of multiple sensors distributed across a large space with one or more base stations. They can measure environmental factors like sound, pollution, temperature, wind. Military uses such as battlefield monitoring drove the creation of these networks. These networks are utilised in industrial and consumer applications such as control and monitoring systems in industries and many other fields. A WSN is made up of sensors or nodes, which can range from a few to hundreds or thousands, with each node linked to additional sensors. Each such node typically consists of several components, including a radio transceiver, a microcontroller, and an energy source like a battery. A WSN's architecture can range from a basic star network to a sophisticated multi-hop wireless mesh network. The data is propagated using technique like routing or flooding.

B. *Simple Mail Transfer Protocol (SMTP)*

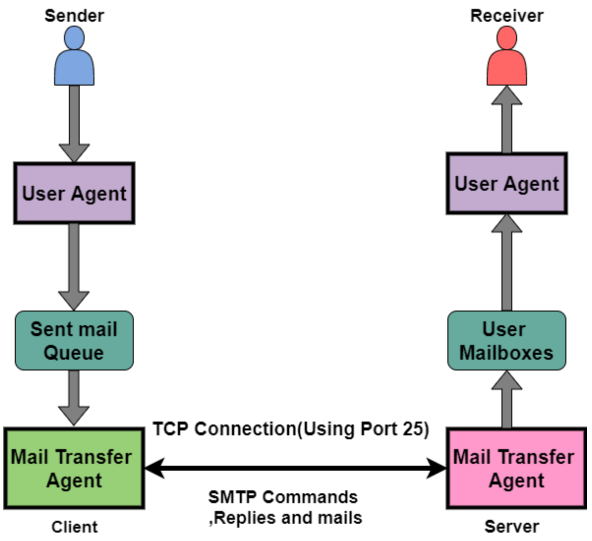


Figure D: SMTP Protocol mechanism

SMTP is an asymmetrical email protocol that is useful for sending electronic mails from one account to another via internet. It is an application that provides a service to multiple clients within a network. When an email is sent using this protocol, the server processes the message and decides the server to which, the mail needs to be sent. Protocol relays the message to that particular server which is then downloaded by the receiver's inbox service provider and not as an independent document.

C. *Security and Authentication Algorithms*

a. AES: The United States government selected the symmetric block cypher known as the Advanced Encryption Standard (AES) to safeguard sensitive data. To encrypt sensitive data, AES is used in hardware and software across the globe. For government computer security, cybersecurity, and the protection of electronic data, it is crucial. AES is an iterative cypher as opposed to a Feistel one. Its foundation is a "substitution-permutation network."

It consists of a number of interconnected operations, some of which substitute certain outputs for inputs (substitutions), while others require shifting bits about (permutations). AES uses bytes rather than bits for all of its calculations. As a result, AES considers a plaintext block's 128 bits to be 16 bytes. For processing as a matrix, these 16 bytes are set up in a four-column by four-row arrangement.

AES has a configurable round count that is influenced by the key length. For 128-bit keys, AES employs 10 rounds; for 192-bit keys, 12 rounds; and for 256-bit keys, 14 rounds. A separate 128-bit round key, derived from the initial AES key, is used for each of these rounds.

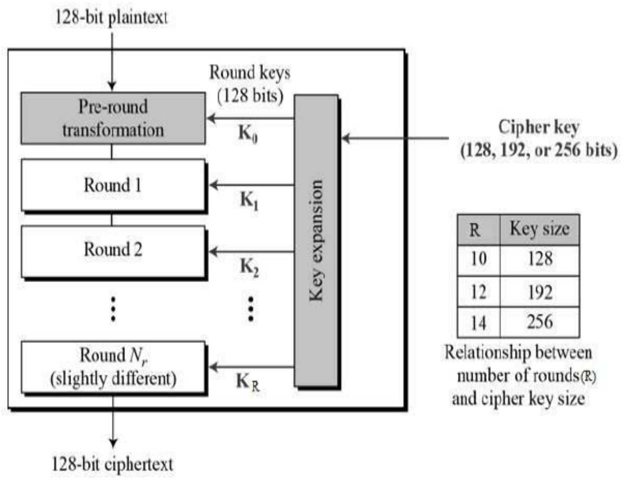


Figure B: Advanced Encryption Standard Algorithm

b. WPA2PSK: The name "WPA2-PSK" refers to Wi-Fi Protected Access 2—Pre-Shared-Key, also known as WPA2-Personal, which is used to secure network access and data transmission utilising the TKIP (Temporal Key Integrity Protocol) or AES (Advanced Encryption Standard) encryption technique. Without an enterprise authentication server, it is made to safeguard networks for home users and small offices. With WPA2-PSK, the user can encrypt a network by entering a passphrase in plain English that is between eight and 63 characters long.

With WPA2-PSK, you give your router a plain-English passphrase between 8 and 63 characters long instead of an encryption key in order to encrypt a network. That passphrase and the network SSID are used to create special encryption keys for each wireless client using a method known as TKIP (temporal key integrity protocol). Additionally, the encryption keys are updated frequently. The main purpose of WEP's support for passphrases is to make it simpler to construct static keys, which are typically made up of the hexadecimal digits 0-9 and A-F.

The most secure personal WPA2 version, and it employs the most recent AES encryption technique. Long passwords are used by WPA2-PSK (AES) to safeguard data, providing residential users with a more secure network. However, as WPA2 requires more processing power to secure networks, users who are using outdated hardware may notice decreased network speed.

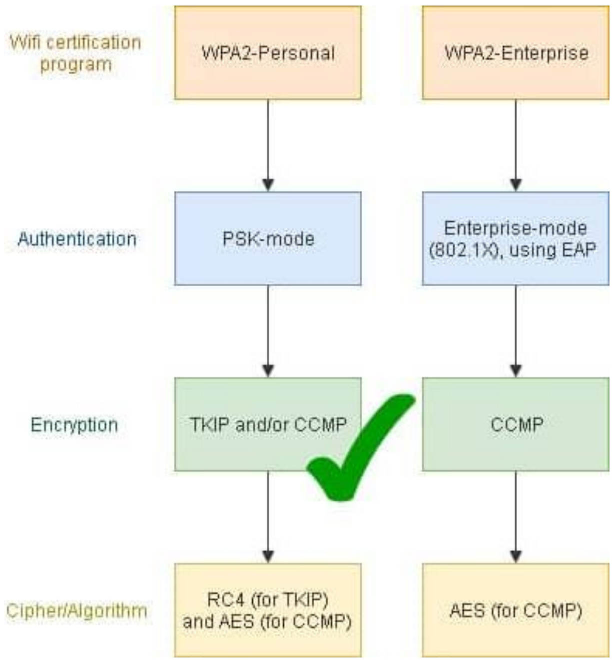


Figure C: WPA2PSK implementation using AES

It has various advantages such as providing a fast network connection is WPA2-PSK. In contrast to WPA-PSK, which is a software security module, WPA2-PSK is a hardware security module. While WPA-PSK can only employ the TKIP encryption protocol, WPA2-PSK uses the newer security standard WPA2 combined with either the TKIP or AES encryption protocol. WPA2-PSK is more secure than WPA-PSK since it uses longer passwords.

D. Cisco Packet Tracer

Cisco Packet Tracer is a thorough networking technology teaching and learning application that provides a singular combination of evaluation, activity authoring capabilities, multiuser collaboration and competition opportunities, and realistic simulation and visualisation experiences. Packet Tracer's innovative features will support teachers and students in collaborating, resolving issues, and understanding concepts in a fun and active social setting.

It provides a realistic simulation and visualisation learning environment as an addition to the classroom's hardware, allowing students to examine internal processes—which are typically buried on real devices—in real time. enables real-time, multi-user competition and cooperation for dynamic learning. enables the creation and localization of structured learning activities like games, laboratories, quizzes, and demonstrations. enables students to investigate ideas, do out experiments, and evaluate their comprehension of network construction. enables the use of virtual equipment to design, construct, install, and debug complicated networks for both students and teachers. provides assistance for a variety of teaching and learning activities, including lectures, group and individual laboratories, assignments, games, and contests.

III. Literature Review

Various researchers have worked on different techniques and ideas for the past couple of decades to include intelligence in the agriculture monitoring systems to reduce the manpower and increase the yield of crops. Xiao [***] projected a farming monitoring framework utilizing an architecture, consisting of remote sensors. Temperature, lightning conditions, and moistness are the environmental factors that can be observed consistently using this network. The hardware and software strategy of the constructed modules, network configuration, and framework correspondence convention comprising of various difficulties are all part of the WSN testing.

The configuration explains how the centre can collect and communicate agricultural data. The framework is more compact, lighter, and excellent in execution. It naturally improves crop yield.

The research proposed by Baker [1] is divided into 4 sections: 3 different sensors, and a PC or mobile app to control the system. Every node in the Farm Information Management system is outfitted with various sensing devices, and they are linked to a centralized web server via wireless communication modules. Using internet connectivity, the server sends and receives information from the user. This system works on both auto and manual mode which controls the operating system by taking its own decisions or giving commands through mobile device respectively.

In [2] M.K.Gayatri and J.Jayasakthi, "Providing Smart Agriculture Solutions to Farmers for Better Yielding Using IoT," cloud based devices that can generate a whole computing system from sensing devices to equipment that perceives data from images of farm and precisely feed the information into cloud servers along with GPS coordinates

Shaik Imam and Dunna Naveen Preetham presented an Automotive Environmental Monitoring System Using IoT Technology in [4]. The purpose of the framework is to create an intelligent system that would provide an optimum environment monitoring. Heat, gas, and moisture levels are sensed by the sensing devices, and digital data is transmitted to a remote server via internet. Using feedback technology, the remote system will be able to supervise the attributes sent by the sensing devices.

In [5] Swaraj C M, IOT-based Smart Agriculture Monitoring and Irrigation System, the aim is to manage agriculture supervision in areas where humans are unable to provide reliability. Angle of inclination, Flame, Moisture levels, Temperature, and IR sensors, that are installed in each segment of the field, will keep updating the parameters via a communication module based on wireless technology. The information is saved in the server. ThingSpeak is an IoT analytics platform that is used to analyze live data stream in the cloud. This is an efficient and dependable system for agricultural monitoring.

IV. METHODOLOGY

The project is a robust network that is capable of sensing multiple parameter values across large fields and collect the data in the form a large dataset. Upon

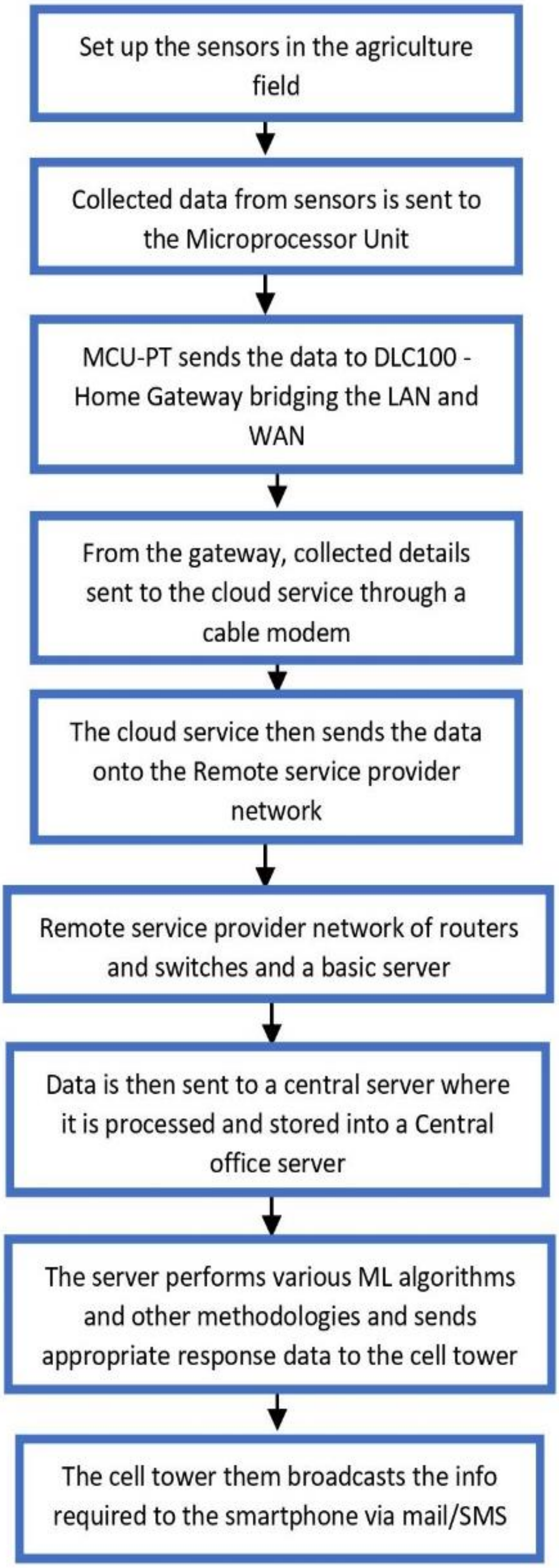


Figure E: Methodology Flowchart

the collection of data using the sensors, an intelligent system is used to train a Machine Learning model. Various approaches are used to predict the best results for the problem statements discussed above. The results are then shared using the SMTP network.

3.1 Data Collection

The first step in building the Smart Agriculture System is data collection. The data is collected from sensors spread across the agricultural land.

Multiple sensors of six different types are responsible for collecting different parameters which are crucial for determining the factors responsible the growth of the crop and condition of the land.

The six types of sensors are- rainfall detector, Nitrogen level detector, Phosphorous level detector, Potassium level detector, temperature sensor and humidity sensor. All the sensors are connected to a single microcontroller unit. This microcontroller is in turn connected to the home Gateway component of the data collection system wirelessly.

In order to ensure the security of the data being collected from the sensors, WPA2PSK authentication is used. This authentication ensures an added layer of protection using AES encryption protocol and hence eliminates the risk of using a shared password in the system.

Both the old and the new devices can use the wireless security standard as the authentication supports TKIP, in addition to AES.

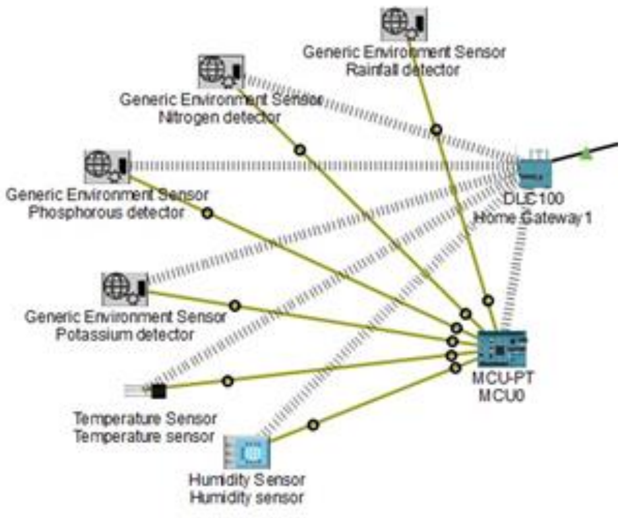


Figure F: 6 types of sensors connected to a microcontroller unit which wirelessly send the data collected from them to Home Gateway

The home gateway is then connected to the cloud where all the data collected from the sensors is stored via the cable modem.

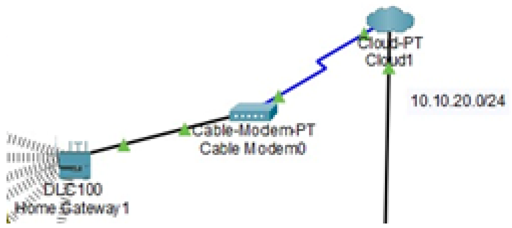


Figure G: Home Gateway connected to cloud via cable modem

This ensures the storage of data centrally and its accessibility through a common platform ahead. The remote service provider network is the next component of the data collection system. The data stored in the cloud is sent to the remote service provider. In this service provider, the data from the cloud is fetched and is stored in a local server.

The remote service provider in the Internet of Things (IoT) context consists of numerous networked devices and systems that generate data, which is then sent to the cloud for analysis. Big data and in-the-moment insights are synonymous with IoT technologies.

Security is a major concern in the IoT industrial environment since sensors, actuators, and other connected devices collect and communicate copious volumes of data regarding processes and operations. Data breaches are expensive and have the potential to cause a systemic breakdown because they can also cause physical equipment damage.

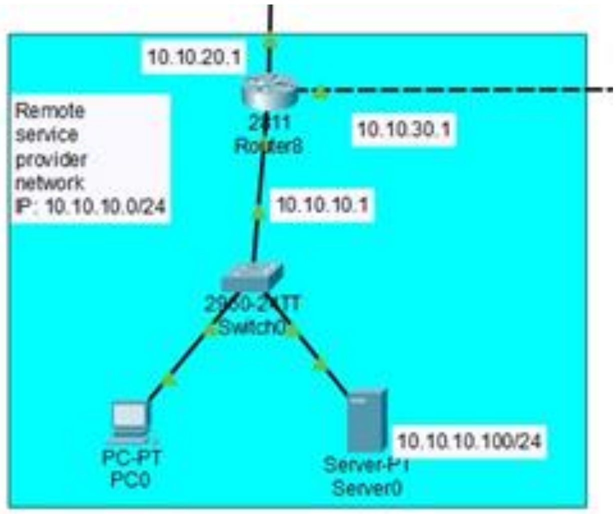


Figure H: Remote service provider

IoT platforms also frequently monitor customer behavior and patterns, and if this data were to be compromised, the firm in question may suffer a loss of

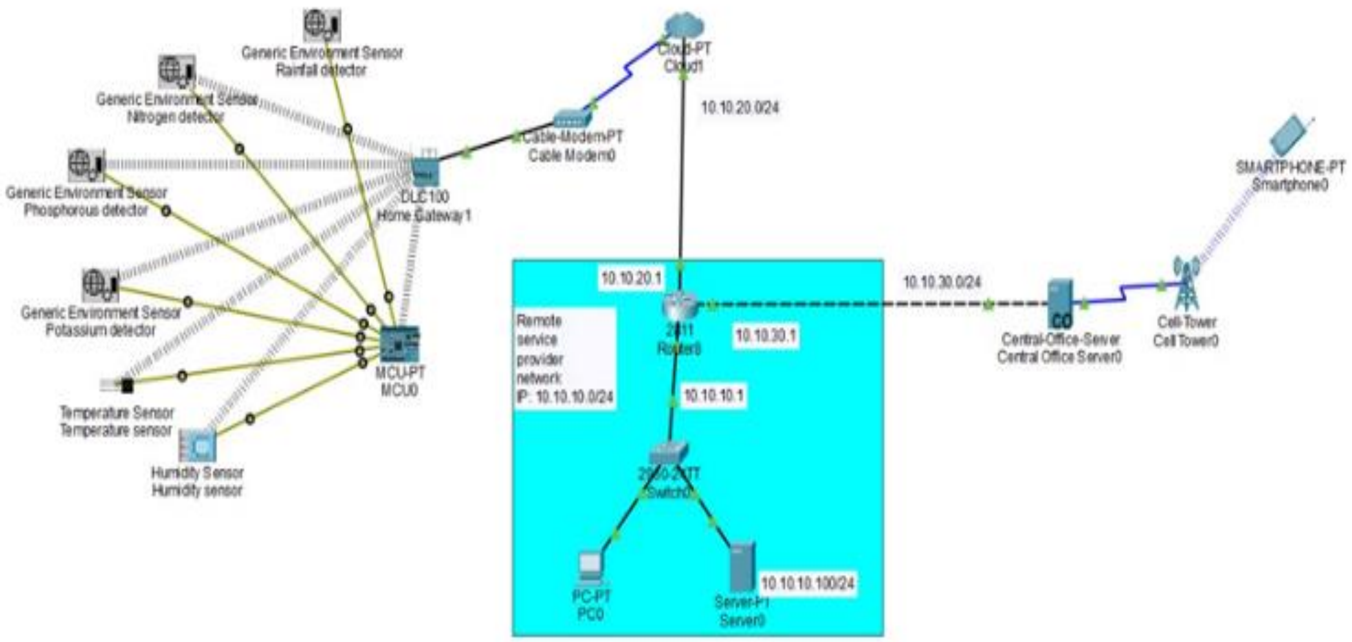


Figure J: Entire System Network implemented in Cisco Packet Tracer

revenue. As a result, integrated remote access, service, and monitoring allow technology providers to not only secure data transmission but also to receive real-time information about data breaches as they happen and immediately rectify the situation.

In the context of the Internet of Things, remote maintenance and monitoring also refer to preventative maintenance and the management of equipment and activities on the factory floor, in addition to data security. For instance, remote support engineers can respond to warnings produced to remotely operate valves, switches, and machine settings using a smart phone. [8]

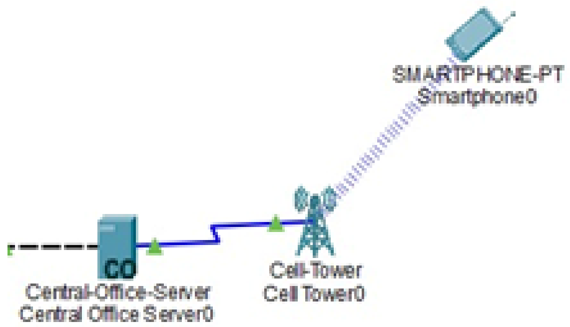


Figure I: Data fetched into a smart phone from a central office server via a cell tower

Since remote service encourages the use of integrated technology in real-time to carry out conventional maintenance tasks, it is a good fit with Industry 4.0 goals. In the past, technicians would have carried out these procedures following a fault-related onsite visit.

One important thing to bear in mind is that a reliable industrial cloud is still required in order to store the data produced by the plant and provide access to remote service support experts for real-time monitoring or analysis of operations.

The data from the server in the remote service provider is fetched into the central office service when there is an incoming data request from a smart phone application. The central office is an office in the locality to which the subscriber home and business lines are connected.

3.2 Preprocessing and preparing the data to feed to Neural Network

The data comprises of 8 columns and 2200 rows. These 8 columns consist of N, P, K, temperature, humidity, pH, rainfall, and labels. There are a total of 22 crops and each crop have 100 datapoints corresponding to each crop label. First, we divide this data frame into 2 variables, X and Y. X consists of all the columns except the "label" one. Y consists of the "label" data which is also called target variable. After that, we are using Label Encoder to transform the word labels into numerical labels. After doing the preprocessing, we split the data into training and testing dataset with 20% testing size and 80% training size.

Following is the dataset we get after preprocessing and cleaning of the dataset.

```
X = df.drop(['label'], axis=1)
Y = df['label']
encode = preprocessing.LabelEncoder()
Y = encode.fit_transform(Y)
```

```
X_train,X_test,y_train,y_test = train_test_split(X,Y,test_size=0.2)
y_train = np_utils.to_categorical(y_train, 22)
y_test = np_utils.to_categorical(y_test, 22)
```

```
X_train.shape
```

```
(1760, 7)
```

Figure K: Code for preprocessing of dataset

	N	P	K	temperature	humidity	ph	rainfall	label
0	90	42	43	20.879744	82.002744	6.502985	202.935536	rice
1	85	58	41	21.770462	80.319644	7.038096	226.655537	rice
2	60	55	44	23.004459	82.320763	7.840207	263.964248	rice
3	74	35	40	26.491096	80.158363	6.980401	242.864034	rice
4	78	42	42	20.130175	81.604873	7.628473	262.717340	rice
...	...	...	...	...	...	...	...	...
2195	107	34	32	26.774637	66.413269	6.780064	177.774507	coffee
2196	99	15	27	27.417112	56.636362	6.086922	127.924610	coffee
2197	118	33	30	24.131797	67.225123	6.362608	173.322839	coffee
2198	117	32	34	26.272418	52.127394	6.758793	127.175293	coffee
2199	104	18	30	23.603016	60.396475	6.779833	140.937041	coffee

2200 rows × 8 columns

Figure L: Preprocessed Dataset

3.3 Building and training the Neural Network

We would be building a neural network using 3 dense layers. Hidden layer consists of sigmoid as the activation function. The last layer consists of 22 output neurons with SoftMax as the activation function. We would employ the Adam optimizer, a stochastic gradient descent method based on adaptive estimation of first- and second-order moments. The loss function that we are using is the Categorical Cross-entropy

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense (Dense)               (None, 512)               4096

 activation (Activation)     (None, 512)               0

 dense_1 (Dense)             (None, 512)               262656

 activation_1 (Activation)   (None, 512)               0

 dense_2 (Dense)             (None, 22)                11286

 activation_2 (Activation)   (None, 22)                0

=================================================================
Total params: 278,038
Trainable params: 278,038
Non-trainable params: 0
_________________________________________________________________
```

Figure M: Model details

It is an information theory measure that is based on entropy and calculates the difference between two probability distributions.

There are total of 278,038 trainable parameters. Now, we fit the model with the training data. We trained it using a total of 100 epochs and used accuracy as the metric for checking the performance.

We trained it using a total of 100 epochs and used accuracy as the metric for checking the performance. After training the model, we tested it using test dataset to check the model's accuracy to predict the correct label using all the required parameters.

3.4 Predicting and Analyzing the data and model

The script gets the input as a CSV file. This file would be read in the form of data frame and would be fed to the Neural Network model. The result would be the prediction of crop label that is best suited for the environmental factors that are fed to the model. We have also used a series of decision-making statements by extensively analyzing the statistics corresponding to the dataset. These decision statements check the suitability of the crops under given environmental factors. The python script also tells which factor is causing the issue and how to resolve it. These decision-making questions is what makes the network system smart and hence gives predictions according to our model.

3.5 Sending message using SMTP

For sending a text message to the concerned receiver, we used Simple Message Transfer Protocol, which is also known as SMTP. For this we have to set sender email and a receiver email along with a password for the sender's email. For security purposes, we created an application under in Gmail that allows to set a different password for application usage only.

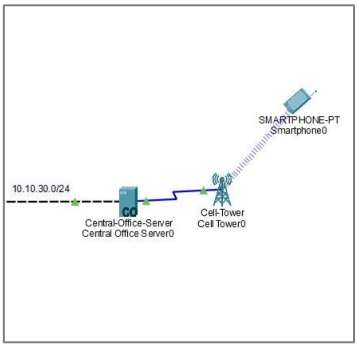


Figure N: SMTP process as per CISCO packet tracer

```
def send_msg(data,subject):
    sender_email = "ravideepdavis@gmail.com"
    rec_email = "ravideepsingh81@gmail.com"
    password = "tffijfhbbzumrypj"

    m = email.message.Message()
    m['From'] = "ravideepdavis@gmail.com"
    m['To'] = "ravideepsingh81@gmail.com"
    m['Subject'] = subject

    m.set_payload(data);
    message = m.as_string()
    connection = smtplib.SMTP('smtp.gmail.com:587')
    connection.starttls()
    connection.login(user = sender_email,password = password)
    print("Login success")
    connection.sendmail(sender_email,rec_email,message)
    connection.close()
    print("Sent!!")
```

Figure O: Code for implementation of mail message responses

V. Results

The model discussed gives us a good accuracy and predicts the labels correctly with minimized error. The accuracy and error are as follows:

```
14/14 [==============================]
Test loss: 0.08282079547643661
Test accuracy: 0.9681817889213562
```

Figure P: Test loss and accuracy for the model trained

We will now discuss examples of our input and prediction output given by the model to the user's smartphone. As discussed above we are focused on answering different queries of the user (farmers) using our smart agricultural system.

4.1 Recommendation for the best fit crop for a set of environmental factors

Example:

Input query by the user:

N	P	K	temperature	humidity	ph	rainfall
91	21	26	26.333780	57.364700	7.261314	191.654941

The query that the user has asked is what crop would be fit to grow in a field which has the following set of environmental factors.

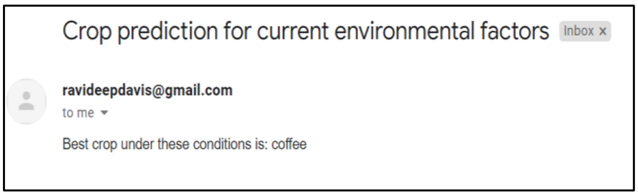
We process the query as it is to and run it through the following model code to find the best fit.

```
N = float(q1_input[:]["N"][0])
P = float(q1_input[:]["P"][0])
K = float(q1_input[:]["K"][0])
temp = float(q1_input[:]["temperature"][0])
humidity = float(q1_input[:]["humidity"][0])
pH = float(q1_input[:]["ph"][0])
rain = float(q1_input[:]["rainfall"][0])
ip = np.array([N,P,K,temp,humidity,pH,rain]).reshape(1,7)
predicted_crop = model.predict(ip).argmax()
print("Best crop under these conditions is: ",encode.inverse_transform(np.array([predicted_crop]))[0])
q1_ans = "Best crop under the current condition of your soil is: "+ encode.inverse_transform(np.array([predicted_crop]))[0]

Best crop under these conditions is:  coffee
```

After running the query, we find that for the following set, "coffee" is the crop which is best fit to be grown in that particular field. Hence, we send the email back to the user/farmer.

Email notification being sent for the particular query:



4.2 Finding if a crop is a good fit for a set of environmental factors

Example:

Input query by the user

N	P	K	temperature	humidity	ph	rainfall	label
19	55	20	27.433294	87.805077	7.185301	54.733676	mungbean

The query that the user has asked is if the crop labelled is suitable to grow in the field which has the following set of environmental factors. This example helps to address the reasons for a crop failure in a field.

We process the query as it is to and run it through the following model code to find the best fit.

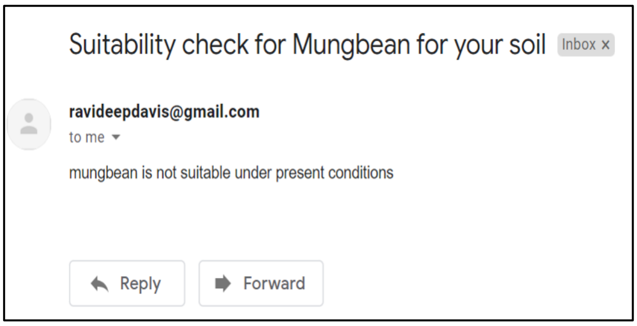
```
if correct_N and correct_P and correct_K and correct_temp and correct_humidity and correct_rain:
    print(input_crop,"is suitable under present conditions conditions")
    q3_ans = input_crop+" is suitable under present conditions"
else:
    print(input_crop,"is not suitable under present conditions")
    q3_ans = input_crop+" is not suitable under present conditions"

mungbean is not suitable under present conditions

q2_ans=""
print(param_adj_results)
for i in param_adj_results:
    q2_ans+=i+".  "
```

After running the query, we find that "mungbean" is not suitable to be grown there. So, we sent an email to the user saying it is not suitable and something else needs to be grown there.

Email notification sent for the particular query:



4.3 Addressing issues of crop failure

Example:

Input query by the user:

N	P	K	temperature	humidity	ph	rainfall	label
19	55	20	27.433294	87.805077	7.185301	54.733676	mungbean

The query that the user has asked is if the crop labelled is suitable to grow in the field which has the following set of environmental factors and if it is not a good fit then find what can be done to change the environment inputs so it is a better fit. This example helps to address the reasons for a crop failure in a field.

We process the query as it is to and run it through the following model code to find the best fit.

```
input_crop = q2_input[:]["crop"][0]
```

```
crop_param_desc = df[df['label']==input_crop].describe()
```

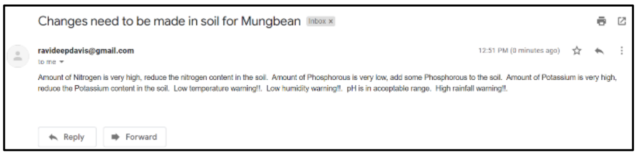
```
N = float(q2_input[:]["N"][0])
P = float(q2_input[:]["P"][0])
K = float(q2_input[:]["K"][0])
temp = float(q2_input[:]["temperature"][0])
humidity = float(q2_input[:]["humidity"][0])
pH = float(q2_input[:]["ph"][0])
rain = float(q2_input[:]["rainfall"][0])
ip = np.array([N,P,K,temp,humidity,pH,rain]).reshape(1,7)
```

```
crop_param_desc
```

	N	P	K	temperature	humidity	ph	rainfall
count	100.000000	100.000000	100.000000	100.000000	100.000000	100.000000	100.000000
mean	20.990000	47.280000	19.870000	28.525775	85.499975	6.723957	48.403601
std	11.510641	7.870261	3.148368	0.841546	2.851356	0.286574	7.117214
min	0.000000	35.000000	15.000000	27.014704	80.034996	6.218924	36.120429

After running the query, we find that "mungbean" is not suitable to be grown there. Further processing we send an email to the user stating what can he do so that their crop doesn't fail.

Email notification being sent for the particular query:



These examples illustrate that the model works perfectly in the restricted conditions that we have.

VI. Limitations

Implementing this approach would assist farmers in producing high agricultural yields by utilising Wireless Sensor Networks and Machine Learning, thereby reducing the workload on humans. Despite the usefulness of this approach, there are some limitations that must be addressed. Wireless Sensor Networks are heavily reliant on internet connectivity.

The collected data cannot be delivered to the host without the use of the internet. Even if there is an internet connection, it must be reliable. This is a significant challenge because establishing a stable wireless connection in large agricultural farms is extremely difficult.

Another issue is the lack of data for training the neural network. There are only 22 crops in the dataset, and each crop has 100 datapoints. This amount of data is insufficient to train a neural network. Furthermore, if a new crop is introduced into the system, it will be unable to provide the necessary inferences. One of the system's limitations is its inability to scale. Our implementation is being carried out on a small plot of farmland. We must work on expanding into large agricultural fields.

The project is also not able to process the data in bulk. It processes each query separately and gives the data for one query at a time.

VII. Future Scope

This entire project is a prototype that is being tested on the Cisco packet tracer. In the future, we plan to implement it with the necessary hardware, such as sensors, a home gateway, a router, and other items detailed in the report. This project will be expanded further by increasing the scale of implementation.

The current concept works extremely well, but only on a small scale with a small number of sensors. We will implement multiple clustered sensor groups that will collectively send data to the user, increasing the system's efficiency and robustness.

Moving forward, we will be implementing actuators that will work on bringing about the necessary changes in the soil for a specific crop to grow perfectly. For example, if the nitrogen content of the soil is becoming depleted for a specific crop, we could automate the task of adding high nitrogen-content manure to the soil. This would result in a significant reduction in human workload and a high crop yield.

The project is also not able to process the data in bulk. It processes each query separately and gives the data for one query at a time. Accommodations need to be done in the code so that it can handle bulk queries at once.

VIII. Conclusion

The project foundation lays on wireless sensor networks, SMTP and Machine Learning. We have used the Cisco Packet Tracer to simulate the network of six different types of sensors used to collect the data with WPA2PSK/ AES authentication. In the virtual simulation of the network, we further implemented the storage of the data on a cloud and a local server. This data was then sent wirelessly to a smart phone using a cell tower from a local server. This data was then used in the Machine Learning algorithms to derive useful insights. The data was preprocessed, and a neural network is designed to fetch the answers for the three problem statements that the project aims to answer.

The SMTP is used to receive the queries and answer these queries. Hence the project, holistically uses the different technologies available to create an ecosystem.

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