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Smart Irrigation and Rainfall Prediction System

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ABSTRACT: In general, agriculture is the backbone of India and also plays an important role in Indian economy by providing a certain percentage of domestic product to ensure the food security. But now-a-days, food production and prediction is getting depleted due to unnatural climatic changes, which will adversely affect the economy of farmers by getting a poor yield and also help the farmers to remain less familiar in forecasting the future crops. This research work helps the beginner farmer in such a way to guide them for sowing the reasonable crops by deploying machine learning, one of the advanced technologies in crop prediction. Naive Bayes, a supervised learning algorithm puts forth in the way to achieve it. The seed data of the crops are collected here, with the appropriate parameters like temperature, humidity and moisture content, which helps the crops to achieve a successful growth. Weather prediction and meteorological analysis contribute significantly towards sustainable development to reduce the damage from extreme events which could otherwise set-back the progress in development by years. The change in surface temperature is one of the important indicators in detecting climate change. In this research, we propose a novel deep learning model named Spatial Feature Attention Long ShortTerm Memory (SFA-LSTM) model to capture accurate spatial and temporal relations of multiple meteorological features to forecast temperature. Significant spatial feature and temporal interpretations of historical data aligned directly to output feature helps the model to forecast data accurately.

I. INTRODUCTION

From ancient days, agriculture is considered as the main source of supply to satisfy the daily needs of human lives. It is also considered a primary occupation, and also one of the India's major industrial sectors. The farmers are ought to follow a traditional naked eye observation and yielded healthy crops without the involvement of chemicals for animals and also to their cultivation land in order to keep healthy diversity. But nowadays, weather conditions are being rapidly changing against the elemental assets to deplete the food and increase the security. In meantime, the GDP in agricultural sector is keep on decreasing, where in 2005 it was about 17.211.1, in 2018 it was 52020 it came down to 2farmers come from rural areas, and if the revenue from crop production goes down, their lifestyle would be influenced by the farms at industry level. Now more than ever, environmental sustainability is becoming extremely crucial. The provisional World Meteorological Organization (WMO) State of the Global Climate 2021 report draws from the recent evidences to show how our earth is changing before our eyes. Weather prediction and meteorological analysis contribute significantly towards sustainable . development to reduce the damage from extreme weather events, to decrease weather-related losses including protection of habitat, livelihood, economy which could otherwise set-back the progress in development by years. Weather forecasting is the prediction of weather conditions for a given location and time through application of science, technology and principles of physics .

1.1. MOTIVATION

key motivation for developing this project is as we say every part of world is developing but we can see that there is no such big achievement or development in soil or crop related issues. So we can give preference to this soil field and if

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we suggest suitable crop to farmers then it is beneficial for them. Weather Forecasting is crucial since it helps to determine future climate changes. With the use of latitude, we can determine the probability of snow and hail reaching 2 the surface. We are able to identify the thermal energy from the sun that is exposed to a region.

II. PROBLEM STATEMENT

1.2.1 Aim of the Project is to design "Rain Forecasting and Crop Prediction Using Machine Learning & Deep Learning Techniques".

1.2.2 This Project will be helpful to develop accurate and reliable models that can predict rainfall patterns and crop performance, enabling proactive decision making for farmers and stakeholders in the agriculture sector.

1.2.3 The rainfall Prediction will be done to LSTM and crop prediction will be done by CNN

III. WORKING

We use the Long short-term memory (LSTM) algorithm to predict the rainfall using historical data that we get from the Kaggle website . the algorithm is work on data preparation , data pre-processing , data splitting , sequence data preparation .

3.1 Data preparation:- Collect a historical weather dataset in CSV format, including relevant features like date, temperature, humidity, wind speed, and, most importantly, rainfall data. Clean the dataset by handling missing values and outliers

3.2 Data Preprocessing :- Transfer the dataset into the suitable format for time series forecasting . this may involve converting the date into a time series format and normalizing the numerical feature

3.3 Data Splitting :- Split the dataset into training, validation, and testing sets. Typically, you use the earlier time periods for training and later time periods for validation testing.

3.4 Sequence Data Preparation :- Convert the dataset into sequences, where each sequence represents a fixed window of historical data. For example, you can use the previous 30 days' weather data to predict rainfall for the next day.

IV. LSTM MODEL

Long short-term memory (LSTM) network is a recurrent neural network (RNN), aimed to deal with the vanishing gradient problem present in traditional RNNs. Its relative insensitivity to gap length is its advantage over other RNNs, hidden Markov models and other sequence learning methods. It aims to provide a short-term memory for RNN that can last thousands of timesteps, thus ”long short-term memory”. It is applicable to classification, processing and predicting data based on time series, such as in handwriting, speech recognition, machine translation, speech activity detection, robot control, video games, and healthcare. A common LSTM unit is composed of a cell, an input gate, an output gate and a forget gate. The cell remembers values over arbitrary time intervals and the three gates regulate the flow of information into and out of the cell. Forget gates decide what information to discard from a previous state by assigning a previous state, compared to a current input, a value between 0 and 1. A (rounded) value of 1 means to keep the information, and a value of 0 means to discard it. Input gates decide which pieces of new information to store in the current state, using the same system as forget gates. Output gates control which pieces of information in the current state to output by assigning a value from 0 to 1 to the information, considering the previous and current states. Selectively outputting relevant information from the current state allows the LSTM network to maintain useful, long-term dependencies to make predictions, both in current and future time-steps. One of the key advantages of LSTM networks lies within their ability to addresses the vanishing gradient problem encountered in traditional recurrent neural networks (RNNs), Because of their gated structures. This gating mechanism enable LSTMs to selectively retain or discard information over time, facilitating the capture of long-term dependencies crucial for forecasting future values accurately. Additionally, LSTMs exhibit robustness to overfitting, courtesy of techniques like dropout. The LSTM model developed for predicting beam irradiance values yielded a mean absolute percent error of 62.600. Despite the relatively high error rate, the model demonstrates its potential for forecasting beam irradiance values based on historical data. The model's ability to provide forecasts based on historical observations underscores its utility as a valuable tool for supporting decision-making.

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V. CNN ALGORITHM

Convolutional Neural Networks specialized for applications in image video recognition. CNN is mainly used in image analysis tasks like Image recognition, Object detection Segmentation. There are Four types of layers in Convolutional Neural Networks:

1)Convolutional Layer: In a typical neural network each input neuron is connected to the next hidden layer. In CNN, only a small region of the input layer neurons connect to the neuron hidden layer.

2)Pooling Layer: The pooling layer is used to reduce the dimensionality of the feature map. There will be multiple activation pooling layers inside the hidden layer of the CNN.

3)Flatten: - Flattening is converting the data into a 1-dimensional array for inputting it to the next layer. We flatten the output of the convolutional layers to create a single long feature vector.

4)Fully-Connected layer: Fully Connected Layers form the last few layers in the network. The input to the fully connected layer is the output from the final Pooling or Convolutional Layer, which is flattened and then fed into the fully connected layer. CNN implementation steps :

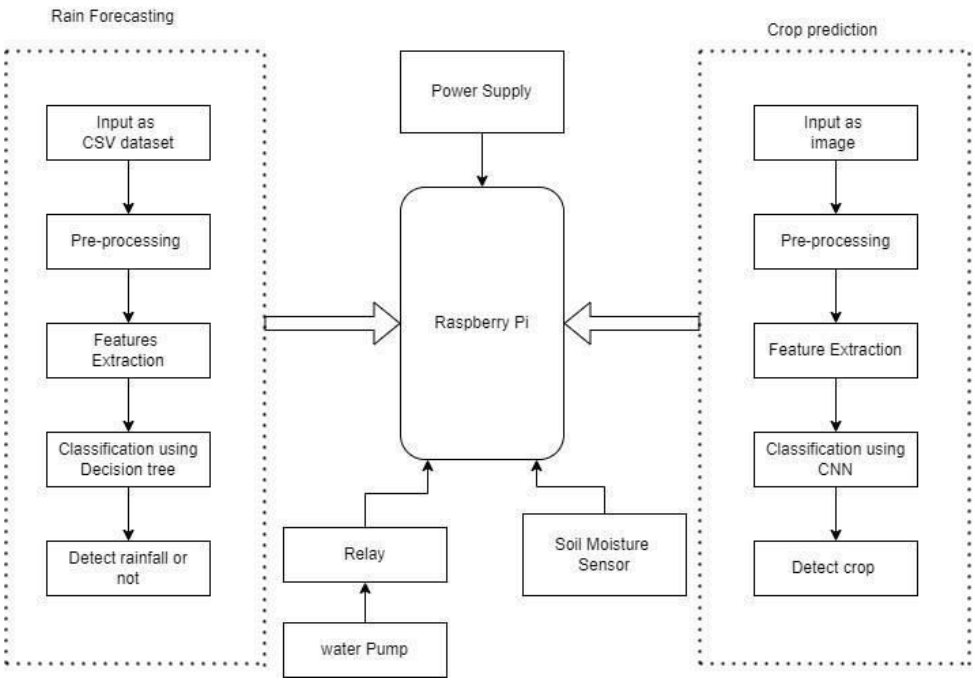
Step 1: Convolution Operation(Filter image) Step 1(b): ReLU Layer

Step 2: Pooling (used max pooling function)

Step 3: Flattening (Covert Matrix into 1D Array)

Step 4: Full Connection.

VI. BLOCK DIAGRAM



Soil moisture irrigation and rainfall detection system using raspberry pi we connect the soil moisture sensor , relay module and water pump and give the power supply to the raspberry pi . inn soil moisture irrigation system we will check the moisture of soil and set the level of soil moisture sensor . if the moisture detect down the set level of moisture sensor then relay module is turn on the water pump .

For rain forecasting we use the LSTM algorithm in this we will give the csv dataset as a input that data is pre-processing then extract the feature then classify using decision tree an at the detect the rainfall or not .

Also for crop prediction we use the CNN algorithm and predict the crop .

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VII. RESULT

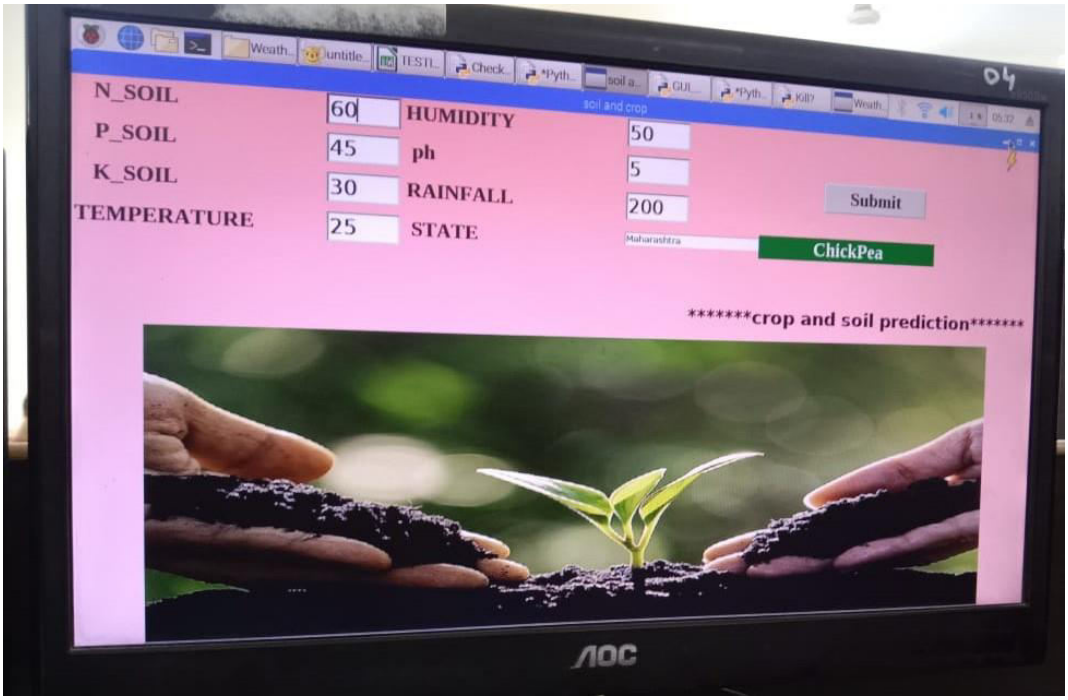

Fig.1 Crop Prediction

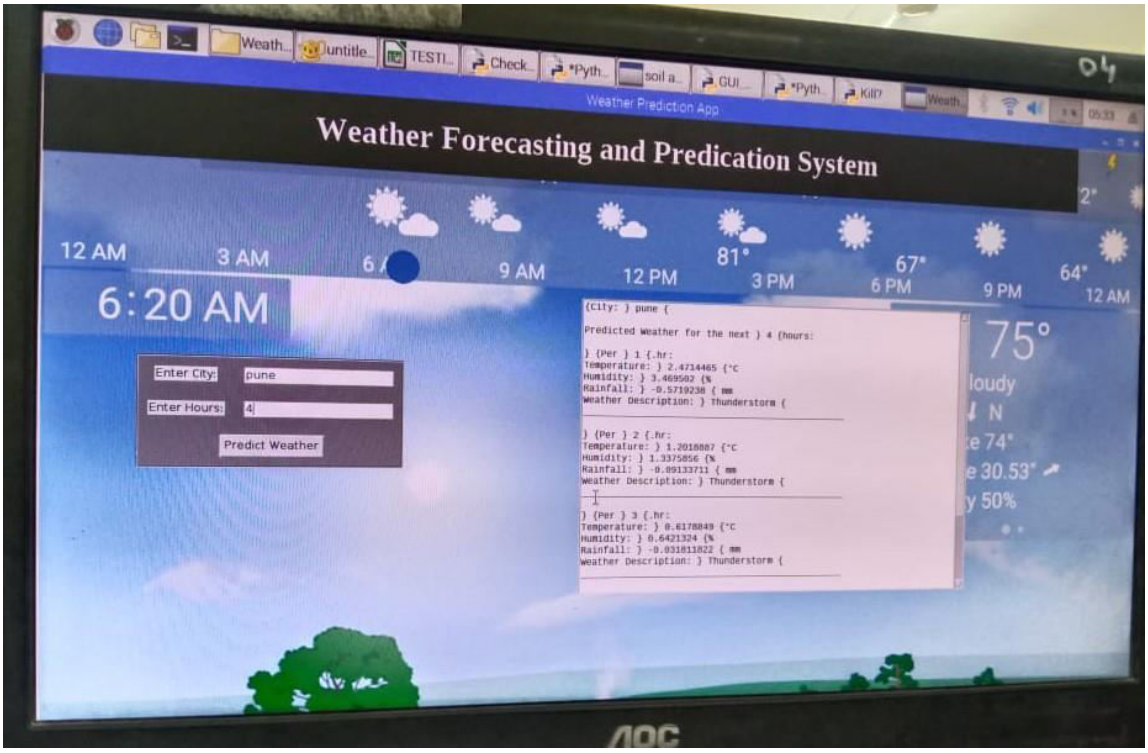

Fig.2 Weather Forecasting and Prediction

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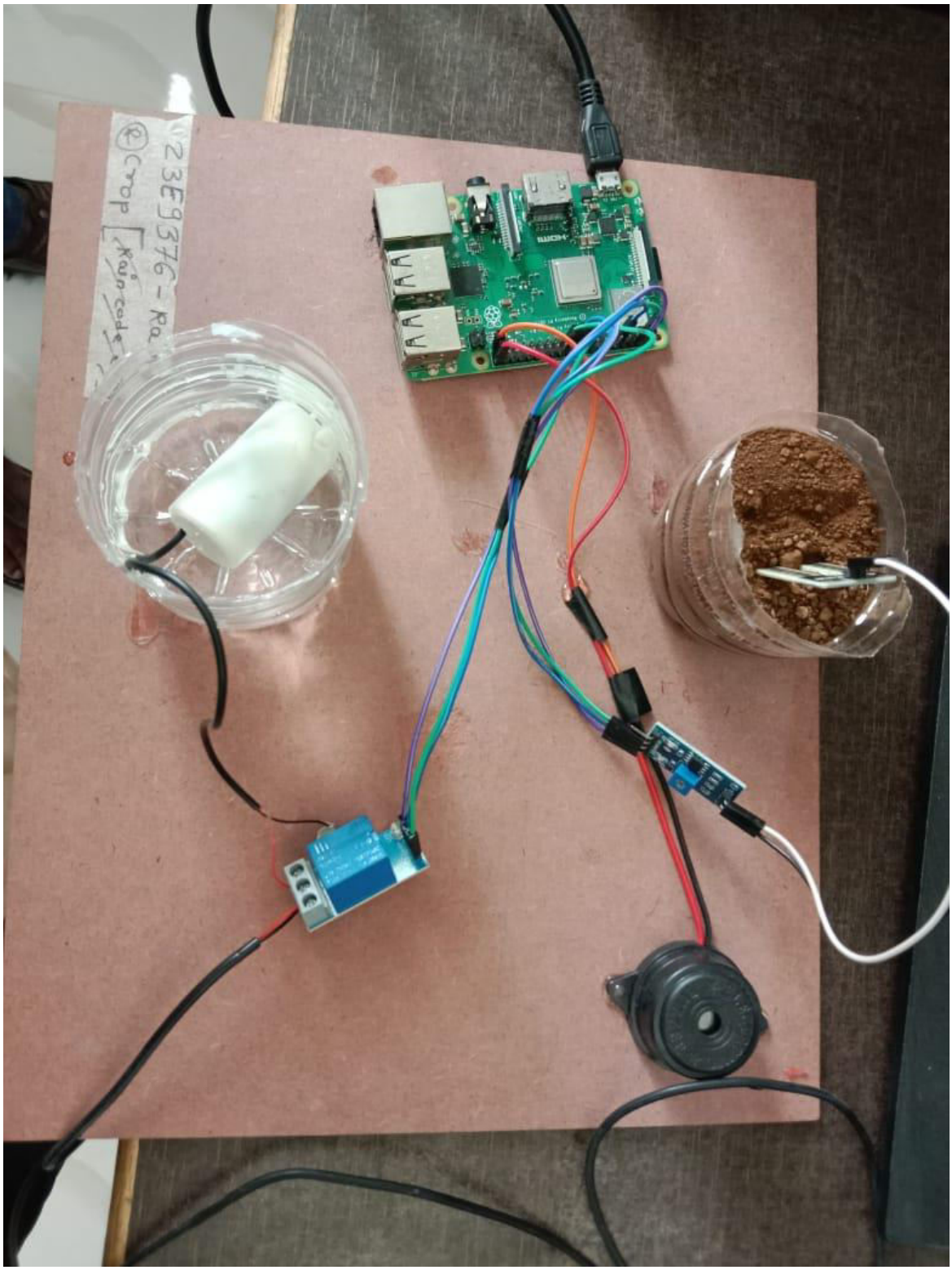

Fig.3 soil moisture irrigation and automatic walve control system

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VIII. CONCLUSION

Agriculture is the field which helps in economic growth of our country. But this is lacking behind in using new technologies of machine learning. Hence our farmers should know all the new technologies of machine learning and other new techniques. These techniques help in getting maximum yield of crops. Many techniques of machine learning are applied on agriculture to improve yield rate of crops. These techniques also help in solving problems of agriculture. We can also get the accuracy of yield by checking for different methods. Hence we can improve the performance by checking the accuracy between different crops.

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