Smart Weather Acquisition, Analysis and Alert system

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Abstract: Climate monitoring is a crucial process since rapid differences in atmospheric condition causes impact on diverse community, budgetary, substantial aspects along with safeness, fitness, nutrition consumption, travel. Hence acquisition of appropriate weather data is necessary to produce right end result. The proposed work presents recording the pertinent data, classification of the processed data with proper visualization techniques perceivable everywhere in the globe. Internet of things function as a feasible mechanism to achieve our task which is adequate and progressive approach to associate objects and connecting whole world of objects to internet. Here objects can become anything which has set of attributes and unique identity like sensors, electronic gadgets, actuators and electrical components. We have used k-nearest neighbor classification algorithm to perform processing on real time data obtained from the sensors to generate useful prediction mechanism. The system organization is responsible for supervising natural parameters such as atmospheric temperature, humidness and wind pressure in order to make wide data analytics and to draw helpful predictive decisions. Information updated from the operating system can be found online from anywhere in the world**.** Weather Information is broadcasted to the farmer or weather forecaster to alert about deluge or drought in the form of Short message to their mobile phone

1. INTRODUCTION

An automated climate location is a device that calculates and accounts weather parameters by means of sensors devoid of any human interference. The calculated parameters can be saved in a database or transferred through a communication connection to a remote location. When the data is saved in a database, the recorded data should be physically downloaded into the mobile application in the future for processing. Thus, a connection device is an integral part of a self-hosted climate station. Currently, automated climate stations are accessible as retail commodities.

With many places and possibilities though in remote areas of Sri Lanka automated weather stations can be installed and used to reduce the cost of maintenance of meteorological stations, there was little focus on building and the use of local instruments.

The Internet of Things (IoT), associates to the millions of mobile gadgets worldwide now allied to the web, all of which gather and distribute information. With extremely cheap chips and the proliferation of wireless networks, anything from something as small as a tablet to anything as large as an aero plane can be converted into part of the IoT [1].Connecting and attaching sensors to all these various systems gives to potentially silent systems a digital intelligence level that can communicate with real-time data without intervention of anyone [2].

Wired connectivity was used for the data transfer to the monitoring station through an integrated USB interface of the device. The latest work is another continuation of previous innovations. The main aim of the work is to build a standalone modular weather station with remote communication facility for weather parameters capture and transmission. In different applications and industrial processes, remote monitoring of environmental parameters is critical. In recent times, weather surveillance systems are usually focused on mechanical electrical devices that suffer from defects

such as poor rigidity, need of human intervention, related parallax errors and reliability. Kang and Park developed an indoor climate and atmosphere sensor monitoring system based on the requirements outlined in 2000.The integration of data acquisition system with numerous sensors in 2005 showed to be an enhanced method to control the various weather parameters in 1993, Vellassov initiated the use of acoustic surface wave devices as temperature sensors.

2. LITERATURE SURVEY

Weather monitoring systems are organized depends on the following enabling technologies.

Wireless Sensor Network Based System

Communication enabled in wireless sensor network is enabled by the means of sensors nodes and gateway nodes. Proposed work performs the classification on types of sinks involved are single or multiple, types of nodes as static or dynamic. This system also classifies whether occurrence discovery occurred or not and arrangement strength of character is enabled or disabled[3].The present work gives the cloud based wireless sensor network facilitation to analyze the climate information and   report as a service software users during disasters due to more variations in the climate at low cost. The work supports node and network level virtualization for climate sensors which is not facilitated in the existing system [4].Wireless sensor network with internet of things together forms PARASENSE architecture [5].

Satellite-Based System

Data acquisition is performed using the satellite data available through global positioning system to monitor and control applications such as weather data gathering and monitoring[6].weather forecasting is achieved by collecting appropriate weather data through parachute satellite system called CanSat and it is built to monitor the climate variations with cost effective solution[7].

Microcontroller Based System

This work focuses on automation and control of device in intelligent buildings based on Microcontroller dependent systems [8] and they aresecured, efficient and constructive for their residents. Proposed work involves the design of automated Fan and air conditioner in the building. Communication between thermometer sensor and the microcontroller is enabled. The information derived from this communication is adjusting the key parameter used by the microcontroller for switch off/on.

Arduino Based System

In many applications weather plays major role. Weather monitoring system impacts on agriculture, flood management and health monitoring; even it has show positive influence on aerospace applications to verify the weather conditions of other planets also.
The proposed work focuses on providing support to access the live weather data using arduino based instruments wherever the concerned authority is residing [9,10].The results can be visualized in the form of graphs and charts.

Prediction Based systems

The proposed work here analyzes the growth of the building with prognostic storage space arrangement. To enclose a elevated scheme recital, the power storage organization have to exist correctly controlled as managing at ease thermal atmosphere intended for the residents[17]. Sales prediction is a vital job in transaction in meticulous customer-leaning business for instance trend in addition to electronics face vague appeal, diminutive life cycles and a be short of of chronological

sales data which fortify the difficulties of creating precise forecasts. This study as well reviews diverse strategies to the prognostic cost of consumer-generated data and seek out queries [18].

Camera-Based System
The organization was intended towards scrutinize the flick of a exacting neighboring through a camera accordance of 1680 by 1050.An enhanced video type examination of organization as a result turn into a primary inclusive deliberate apparatus in favor of skirmishing the confrontation beside intimidation, preventing offense, defensive oblige material goods along with attractive community protection which has completed argumentative inspection incredibly accessible for the police [20]. Considerable boosts during the quantity of supervision camera organizations have not delivered the guaranteed determinant belongings or exploratory casing verification with its usefulness has been insipid. A Probable explanation to realistic camera supervising desires is computer apparition improved camera network with the aim of computerized immediate video examination, rapid dispensation of verification and investigation of precise video files. The growth in the supercomputer visualization laboratories is obtainable along with connotation on or after their acceptance through safety agency on top of the civilization.

Sensor-Based System
The anticipating continuation on the whole contains of peripheral. The particular peripherals do the state monitoring, recognition, verdict in addition to the prospects intended for recognition for deviation identification and defective circumstances. The state supervising is one of the several parameters to identify the unseen state of affairs. The discovery is represents if nearby is an uncharacteristic condition by means of visibility within an organization [19].

3. Description of the technology used
This includes a mobile device emulator which works directly on the computer. We prototyped designed and tested our application without a physical computer using this emulator.

My Structured Query Language
My structured Query Language (MySQL) is a relational database management framework that is open source. MySQL databases store information as tables linked to it. Usually, MySQL databases are used for the creation of the web app (frequently accessed with PHP). C, C + +, Eiffel, Java, PHP and Python can directly enter the MySQL database (Query).A subset of standard structured query language (SQL) commands is used to access the MySQL database

Python
Python is a highly structured semantic, object-oriented, interpreter of programming language. These integrated high-level data structures, alongside a dynamic shapewith connection make it highly desirable for rapid application growth.

Android SDK
This includes a mobile device simulator that operates directly on the computer and a virtual device simulator. We prototyped, designed and tested our application without a physical device (when no one was available) with the assistance of this emulator.

PHP Hypertext Pre-Processor
A scripting language for network creation on the server side but is also used as a general programming language. It can be used with a wide range of site templates, network data supervision

organization in addition to web frameworks. PHP source code can be implements in Hyper Text Markup Language.

Android Studio
It is the official application Integrated Development Environment (IDE). On the basis of the programme IntelliJ Concept of JetBrain, Android Studio will be designed for Android development.

K-nearest neighbors (KNN) algorithm
This algorithm uses attribute resemblance to foresee the numerical of novel data nodes in the K-nearest neighbors (KNN) algorithm[22], which says with the intention of the new data node will be delegated a value depends on matching the nodes available in the training set[23].The algorithm steps are given as below-

Step 1 - To implement any algorithm dataset is needed first. Thus this stage of KNN training set is loaded along with the test data.

Step 2 - Choose the rate of K i.e. the adjacent data node. K is any numerical.

Step 3 - Repeat the below for every node within the test data -Use any method to find out the space between the investigation and training data. Euclidean distance is the popular approach to check the distance.

- depends on the value obtained from the distance, arrange them in increasing order.
- Pick the highest K rows starting from the planned collection
- allocate a set to the test point depends on recurrent class of these lines.
  Step 4 –End

4. IMPLEMENTATION
Algorithm: K Nearest Neighbor Algorithm to Pre-Process the data

Step 1: Defining the Dataset
Assigning the attributes and #First Attribute
Weather=[' sundrenched ',' sundrenched ',' cloudy ',' cloudy ',' cloudy ','rainy', 'rainy',' sundrenched ',' sundrenched ']
#Second Attribute
Temperature=['blazing', 'blazing ','moderate', 'moderate', 'chilled', 'chilled', 'moderate',' blazing ',' blazing ']
#label or target variable
Flood=['No', 'No',' No ',' No ',' No ','Maybe', 'Maybe', 'No', 'No']

Step 2: Data Conversion
A variety of device erudition algorithms necessitate arithmetical input information, thus one required to stand for definite columns in a arithmetical column.
Map each value in the direction of a digit. e.g. Sundrenched: 0, cloudy: 1 and rainy: 2
For temperature encode it as blazing: 0, moderate: 1, rainy: 2

Occurrence of flood can be viewed as No: 0 and
maybe: 1
Import preprocessing // Import Label Encoder
varen= preprocessing.LabelEncoder ( ) // Creating Label Encoder
weather encoded=varen.fittransform(Weather)
//switching string labels to numerical print (weather encoded)
temp_encoded= varen.fit.transform (Temperature)

Step 3. Combining the attributes
Label= varen.fittransform (Flood) Attributes=list (zip   (weather encoded, temp_encoded)

Step 4: Initiate KNN Classifier Model
Import KNeighborsClassifier
Model= K Neighbors Classifier (n neighbors=3)
model.fit (features, label) //Prepare the model by means of training groups
Result=model. Predict ([[1,2]]) //1: cloudy, 2: moderate print(result)
Output:[0] //result can be viewed as No chances of flood can be expected for cloudy weather having
moderate temperature.

Modular structure

This is a procedure of gathering and clarifying information, recognizing real time problems and disintegration of a structure into its modules. Weather monitoring scheme has many modules like Data Acquisition module, Storage module, processing module and visualization module for datagathering, storing, processing and visualization respectively. The Figure 2 demonstrates the modular organization connected with the planned system.
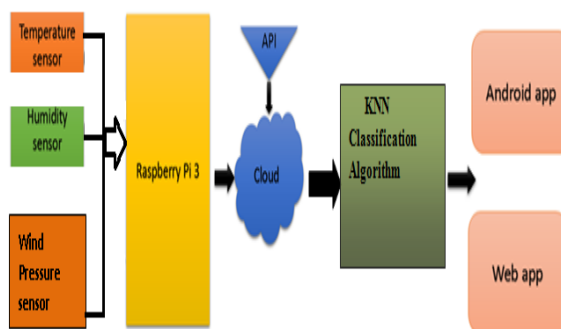

Figure 2 Modular organization of the proposed system

Platform used and coding Language

The Raspberry Pi is a tiny, reasonably priced solo-panel computer used to plan and develop the proposed system by connecting programming and computer hardware. Raspberry Pi environment is set up on the Linux operating system. We have used python programming language to write instructions and communicate to the hardware. Android Studio official integrated development environment (IDE) is used at the visualization part to visualize the results on application using PHP Hypertext Pre-Processor (server side scripting language) and My Structured Query Language.

Dataset

We have taken real time weather data for our work. With the help of sensors we are able to gather temperature, humidity and wind pressure data of different locations of same place for 10 days for every 3 hours. We have not used any existing data set.

5. FLOW CHART

A flowchart is a diagram showing a procedure program or else processor algorithm used broadly applied in many fields to write, revise, edit, develop in addition to interact to multifaceted action often apparent and self-explanatory illustration The following **Figure3** show the flow diagram of the projected system.
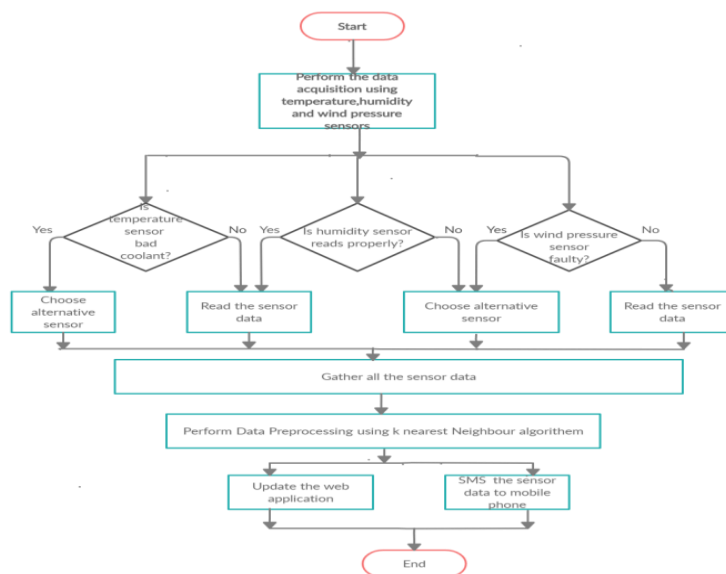
Figure 3 Data Flow Diagram of the planned organization

6. SOFTWARE TESTING

The software test is a research to provide information on product quality [24] or service testing for stakeholders. Software testing may also include a purposeful, objective analysis of software that helps businesses to consider and recognize the risks involved in implementing the programme. Test methods [25] require the execution of a programme or procedure in order to detect software errors.

Table 1 depicts the possible test cases and its status as pass or fail

Test Case no	Input	Expected Behaviour	Observed Behaviour	Status P=Pass /F=Fail
1	Check weather temperature sensor is a bad coolant?	Sensor is not overheated.	As expected	p
2	Check weather humidity sensor is reads data correctly?	Humidity data is readable.	As expected	p
3	Check weather wind pressure sensor is faulty?	Wind pressure was not failing frequently.	As expected	p
4	Check alert message is sent If temp >20?	Alert message is not sent	As expected	P
5	Check alert message is sent for temp>40	Alert message is not sent	As expected	P
6	Check alert message is sent for 0gm>humidity<30gm	Alert message is not sent	As expected	P
7	Check alert message is sent for humidity>30gm	Alert message is sent	As expected	P

Accuracy

Accuracy of our proposed work can be measured by correct flood alert message sent to the user when temperature exceeds 40 and humidity exceeds 80gms.When we performed the test for 75 times user was able to get correct alert message for 60 times. Hence the accuracy of our work can be said as 80 percent.

7. RESULTS AND SNAPSHOTS

The following section describes the results of our proposed work. Data required for the work and processed data is shown in the Table 2 and Table 3 respectively. Snapshots of the result obtained are shown in the Figure 5, Figure 6 and Figure 7 correspondingly. Graphical depiction of the minimum, minimum and average weather parameters are shown in the Figure 8, Figure 9 and Figure 10 in the order shown.

Table 2 Depicts the acquired during data acquisition.   **Table 3** Presents the Processed Data

DAY	Temperature (C)	Humidity (Gm)	Wind Pressure (Pounds)
DAY 1	42	94	14.1197
DAY 2	18	70	14.2646
DAY 3	20	80	3.0284
DAY 4	24	58	14.1036
DAY 5	26	68	11.0446
DAY 6	21	79	13.9587
DAY 7	36	81	12.3648
DAY 8	44	89	14.1519
DAY 9	41	82	11.3183
DAY 10	17	75	12.5258

DAY	Temperature (C)	Humidity (Gm)	Wind Pressure (Pounds)
DAY 1	High	High	High
DAY 2	Low	Moderate	High
DAY 3	High	High	Low
DAY 4	Moderate	Low	High
DAY 5	Moderate	Moderate	Moderate
DAY 6	Moderate	High	High
DAY 7	High	Low	Low
DAY 8	High	Low	High
DAY 9	High	Moderate	High
DAY 10	Low	High	High

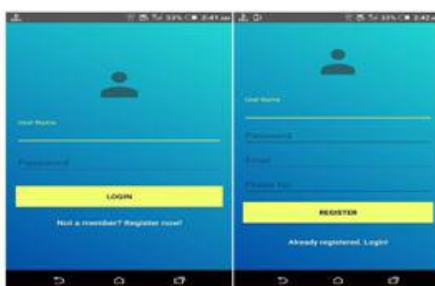**Figure 4** communications between Raspberry Pi and the system

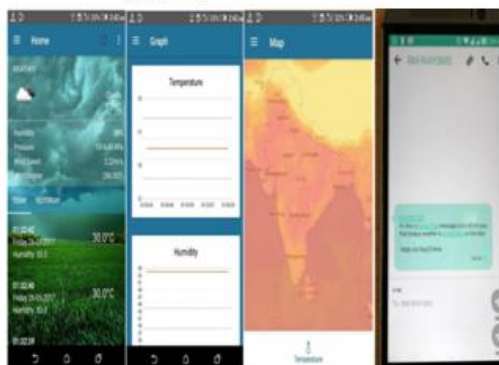**Figure 6** Registration and login page of the Web application

Figure 5 Temperature, Humidity, and Pressure and Web application for the data for the last 5 hours And Phone alert system
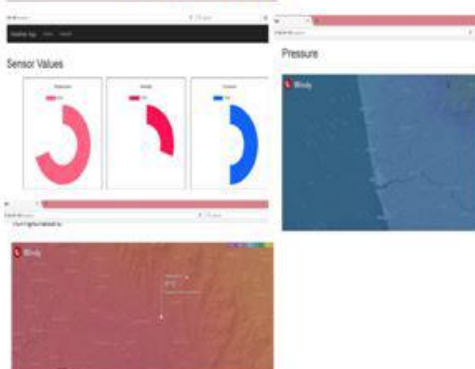

Figure 7 depicts the sensor values and readings for Pressure and temperature in the web application Clima
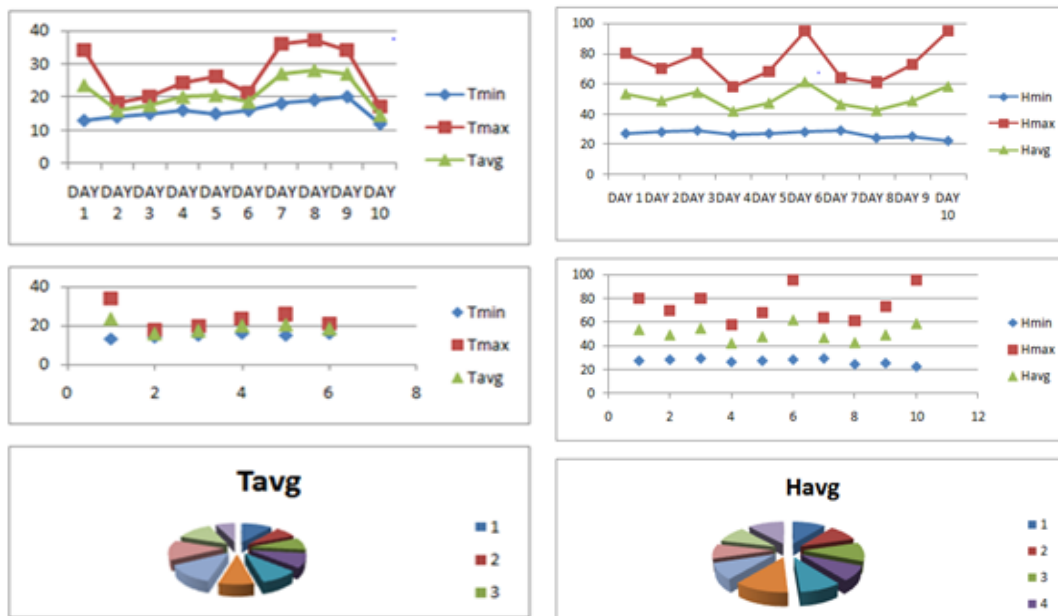
Figure 8 Provides the graphical view of temperature
Data with smallest, greatest and usual
Temperature of each day

Figure 9 Provides the graphical view of Humidity
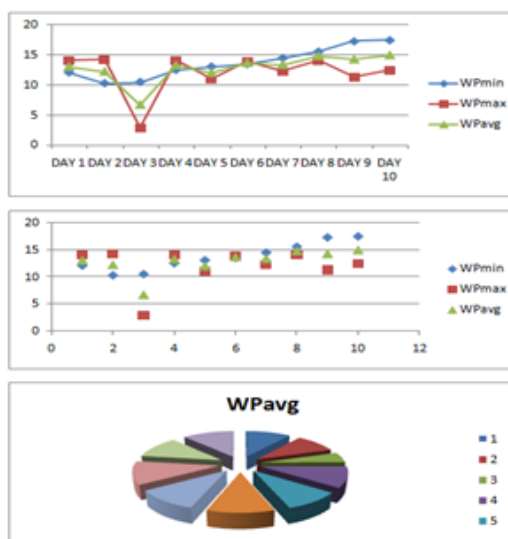Data with smallest, greatest and usual humidity of
Each day

Figure 10 Provides the graphical view of Wind pressure
Data along with smallest, greatest and usual Wind pressure
Of each day.

8. CONCLUSION

This project's main objective aims to create and execute a simple and affordable wireless weather station to remotely control the weather, classify processed data through the KNN algorithm, and move them to database. Data retrieval happens through Android Application. The sensors have been installed in a device that uses information and communications technology to track and measure the gas, temperature and humidity and air pressure levels. In order to do this, sensor devices must be installed in the field for data collection and analysis. The system can be taken to real life i.e. by installing sensor devices in the field. It can communicate through the network with other objects. The data obtained and results of the study are then presented to the end user.

9. FUTURE ENHANCEMENT

Adding more capabilities for tracking other environmental parameters such as Soil PH, CO2 and oxygen sensors to further interpret and forecast data for multiple applications. Additional tracking devices such as a Wi-Fi camera can also be incorporated to manage the growth of the agricultural product and forecast future results based on historical data.

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