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IOT-BASED REAL-TIME REMOTE WEATHER MONITORING SYSTEM

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Abstract: In Today's World, realizing live ecological condition is perhaps the greatest issue on the grounds that there is an IoT of obstacles shows up when live ecological condition is estimated. The proposed framework will eliminate this issue since it screens constant atmospheric conditions.The proposed framework will chip away at the client-server design model utilizing IoT. The framework is coordinated in Two-level Architecture. Our proposed framework contains a different sensor which will screen the temperature of the district, moistness, Rain esteem and strain of the framework. The sensor caught information and send it to the hub MCU regulator. Arduino ide is used to transfer the detected information. The HTTP convention is utilized to see the information on the webserver In the wake of obtain results from the different sensor, it is seen that our proposed model accomplishes improved brings about correlation with the standard climate boundary. With the advancement in microcontroller innovation, web availability, distributed computing and scaling down of electronic parts, it has now become conceivable to interface actual items to the Internet making the World Wide Web an 'Web of Things (IoT)'. Shrewd conditions made utilizing Internet of Things can give energy proficient answers for everyday difficulties. The paper has examined the evidence of idea for an IoT gadget that gathers information concerning boundaries, utilizing a refined microcontroller stage, from different sorts of sensors, through various methods of correspondence and afterward transfers the information to the Internet. The introduced gadget has been intended for remote checking of climate boundaries. The paper focusses on the strategy of transferring gained information on the web, so that the gadget can be utilized to remotely screen climate boundaries and at last investigate environmental change designs. The paper too examines the essential idea of Internet of Things and its likely applications, particularly for climate checking.

Keywords: Internet of Things (IoT), Remote Weather Monitoring, IoT Applications, Environment Monitoring, Arduino, Twitter.

1. INTRODUCTION

Observing weather pattern's assumes a broad part in each individual's life. The effect of the climate's condition causes various difficulties in different fields like agribusiness, industry, developments as well as more different fields. However, the deliberate effect happens for the most part in agribusiness and industry. Obviously, agribusiness play out a vital job in India's Economy. Practically One fourth of India's economy is gained from Agriculture. Over the new year, savvy farming was a discussed point on the planet. In IoT [13,16], the shrewd word demonstrates that the utilization of least boundaries creates a improved outcome. It diminishes the utilization of land, water, time as well and the purposes of the new innovation and science for the improvement of yields. The security is one of the significant issues [17,18] in IoT organization, parcel of safety methods are accessible yet numerous few conceivable outcomes to improve the current

security. In horticulture, Before the yield, the Farming system comprises of a few stages and in that weather conditions plays the most broad job. In Gorakhpur Region, the circumstance of downpour generally occurs. It is arranged close to the line of India "Nepal" and Nepal is a bumpy region because of which thestormy circumstance happens generally. Because of this present circumstance, thecultivating issue happens because of weighty precipitation. In thiscircumstance, a sign of weather pattern's is ansignificant perspective prior to planting or procuring the yields.Consequently in this present circumstance, the observing of climate'scondition [14,15] would assist ranchers with the assistance of a weather conditions observing framework. S It will help the rancherprior to harvesting and planting. In Gorakhpur Region, thecomplete geological region of this district is around 3488.8square km and cultivable land is 26428 hectares, Inwhich the level of flooded region is 76.5 %. Theprincipal harvest of this district is Paddy. The all out region isaround 152655 hectares. How much water whenever becamehigh then it will be an issue for ranchers. Since in theplanting of paddy it needs water adequately yet on the off chance that theamount of water will develop then it ought to be an issuefor rancher. Along these lines, to eliminate this issue, on the off chance that the climate'scondition is realized then it will be valuable for them.The principal objective of our framework is to give ansign of whether that would be valuable for theranchers prior to planting crops or procuring crops.

Web of Things (IoT) can possibly make the world more affable for present and future ages of humankind. IoT gadgets can be sent in various ways for supportable turn of events. An IoT [1] gadget can be utilized to quantify physical boundaries relating to an actual item and transfer them constant to a web-based archive for example to a cloud capacity where they could be dissected continuously. Consequently, the deliberate information can be seen from anyplace all over the planet utilizing Internet-empowered gadgets. IoT, incorporated with distributed computing, permits for decentralization of information stockpiling, handling and investigation. The gathered information can likewise be utilized to naturally control other far off gadgets, utilizing machine-to-machine (M2M) correspondence through the Internet. Because of these elements, an IoT gadget empowers remote checking of the climate without the need to much of the time visit the site. This can make checking conceivable even in troublesome geological landscapes. It can likewise decrease the labor supply prerequisite furthermore, subsequently the gamble associated with visiting ungracious locales. Further, it can lessen the utilization of fuel what's more, energy expected to visit the site, consequently decreasing contamination and carbon impression. IoT can likewise give computerized energy effective answers for everyday applications. The major parts [1] of an IoT gadget are: Control Unit, Power Supply, Input Devices, Yield Devices, Internet Mechanism and so on. An IoT gadget can productively associate actual items put at a huge span from one another without the need of direct actual association. Hence, IoT gadgets have critical applications in practically all fields. Some of them are as per the following:

1. Medical services

Implantable as well as wearable remote gadgets can be utilized to screen basic boundaries of a patient's body progressively, accordingly working on the productivity and viability of medical services arrangements, particularly during crises.

2. Auto Applications

Boundaries like motor temperature, tire pressure, hydrodynamics, speed, fuel level and so forth. can be observed progressively to decide important security measures.

3. Fabricating Sector

Checking each progression in an item life cycle can assist with making fundamental strides for achieving higher exactness and accuracy in the fabricating process.

4. Energy Efficient Solutions

Different gadgets like forced air systems, radiators, garden sprinklers in homes, workplaces and so on can be turned on somewhat provided that the sensors show a requirement for the equivalent, subsequently assisting with moderating energy.

5. Brilliant Metering for Smart Cities

Brilliant metering includes laying out correspondence between different meters of ordinary use (for instance, gas or power meters) and a focal station. This makes the information capacity and charging unified and hence expands the unwavering quality and exactness of the charging process. Improved administrations made accessible through shrewd metering can likewise assist the buyer with observing and make due the utilization of the assets. Savvy metering frameworks combined with energy proficient arrangements, for utilization of municipal assets, can contribute fundamentally to the turn of events of shrewd urban areas.

6. Ecological Monitoring and Management

Incorporated Information Systems [2] can be fostered that consolidate innovations like Web of Things, Cloud Computing, Remote Sensing, Geographical Information Framework, Global Positioning System and so on for checking the climate and examining environment examples and changes in them.

2. DEVELOPMENT OF A MULTI-SENSOR WEATHER MONITORING SYSTEM

The purpose of this study is to create a weather monitoring system. system that will monitor the weather conditions and Continuously monitor realtime environmental parametersvia the internet The weather surveillance system takes use ofto monitor the characteristics using multiple sensors.

Mode 1	If mode 1 presents, DHT11 i.e., temperature and pressure, if it is on, then it captures the temperature value and represents it on the webpage
Mode 2	If mode 2 presents, BMP 180 i.e., it shows the barometric pressure of the environment.
Mode 3	If mode 3 present, the Rain sensor module i.e., it shows the rain value of the environment.

Table 1: Weather monitoring system with many modes

Sensor node-1	Sensor node-2	Sensor node-3
DHT11 (Temperature and pressure sensor)	BMP 180 (Barometric pressure)	Raindrop sensor (Rain sensor)

Table 2: Sensor nodes grouped in various ways.

An original weather conditions checking framework utilizing IoT isproposed. In this paper, the creator presents 3 uniquesensors coordinated in various types of groups in theframework. The model depicts how the sensor isassociated with the microcontroller hub MCU. Sensors areassociated with the hub mcu8266 in the engineering.The framework is organized thusly that information willnaturally bring from sensors and will transfer whileinterfacing with wi-fi and shows the information on thewebsite pages. The proposed model purposes three sensors impliedto secure temperature, pressure, dampness, raindropswhich are displayed with mode1, mode2, and mode3 inabove table 1. The modes are portrayed as Temperaturealso,

mugginess (MODE-1), Barometric strain (MODE2), and Raindrop sensor (MODE-3) addresses in table 2also. By combining table 1 and table 2 shows asMode 1 demonstrates as Sensor hub 1 which contains 1DHT11sensor for estimating the temperature anddampness of the climate. Mode 2, shows sensor 2which contains BMP 180 sensor for estimating thebarometric strain from the climate. Furthermore, the lastone is Mode 3, which shows sensor 3 that contains araindrop sensor, its name recommend it show, it is utilized tomeasure the raindrops from the climate. Theproposed framework is a viable weather conditions checkingframework with less no. of sensors. It is dependable and furthermorefree and accessible openly. we can utilize numerous sensorsfor weather conditions observing like breeze speed, wind course,PIR sensor, and some more. Be that as it may, in our proposed modelwe are utilizing three sensors to actually look at the working of theframework and unwavering quality of the framework. The proposed modelmeasures the exact worth of the naturalcondition.

The introduced plan is a proof of idea for a independent IoT gadget covering various sorts of sensors viz. twofold switch sensor, simple sensor and computerized piece stream sensor alongside both wired and remote methods of correspondence to the control unit. This multitude of kinds of sensors and methods of correspondence are exhibited for IoT, through a remote weather conditions observing framework which measures the accompanying climate boundaries:

1. Light: Using a photodiode as a wired parallel switch sensor

2. Mugginess: Using a wired simple stickiness sensor

3. Temperature: Using a computerized piece stream temperature sensor through remote medium utilizing remote RF modules. The light boundary is utilized as a contribution to control lamp(s) which turns on when it is dim and turns off when there is light. Utilizing an Ethernet association, the climate boundaries are transferred to a Twitter [3] account which consequently time-stamps the information. The block chart of the gadget is displayed in Fig. 1. The sorts of sensors and methods of correspondence can changed accord to necessities of explicit applications.

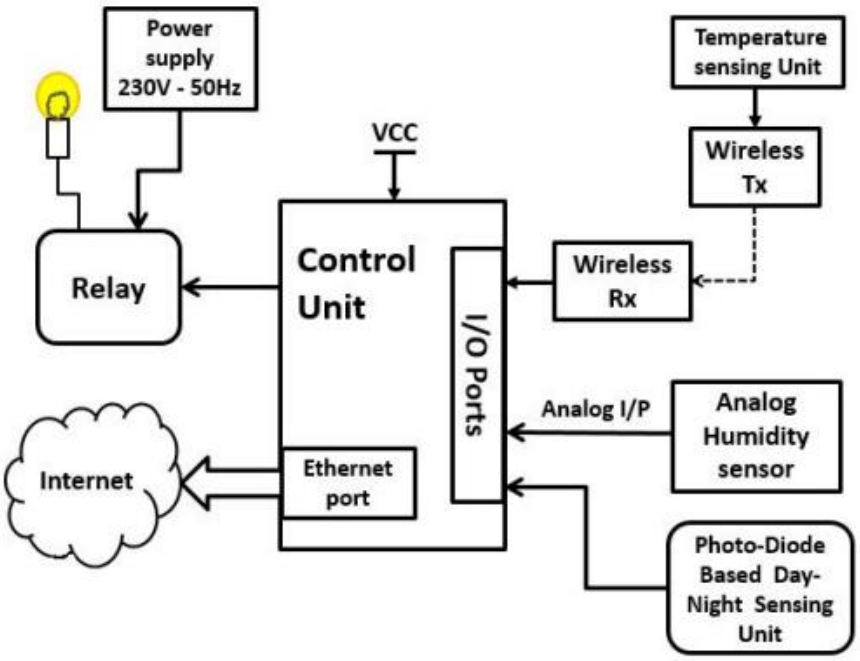

Fig 1: IoT Device for Weather Monitoring System

The introduced plan depends on the Arduino Uno R3 (Arduino) [4] stage which is fitting for the straightforward application viable, in contrast to more high level stages like Raspberry Pi [5]. Not at all like the processor-based Raspberry Pi [6], the Arduino is a miniature regulator based stage. Accordingly, it tends to be more application explicit, making ideal utilization of memory and I/O assets and consequently

diminishing its expense. The utility of the introduced plan lies in the straightforwardness of execution brought by the microcontroller based stage. IoT gadgets in light of Arduino have been planned in which information must be gotten to by entering the IP address relegated to the gadget in the internet browser [7]. Likewise, these gadgets will quite often transfer just current information [7][8], which does not permit information logging and investigation. In certain frameworks [9], the deliberate boundaries can be perused by the client in "on request" mode. Contingent upon the kind of information, a few frameworks [10] transfer information to a Google Calculation sheet and make it secretly available to the approved client. Since, the introduced gadget transfers the information to a Twitter account, the information is available from anyplace all over the planet. It can likewise be made available to everyone whenever required. Devotees of the record can be informed of updates. Further, keeping up with record of the past is conceivable information which can then be examined to separate information about environment designs.

2.1 CONTROL UNIT

The focal control unit utilized in the introduced IoT gadget is the refined microcontroller based stage Arduino Uno R3 (Arduino). The Arduino Coordinated Development Environment (IDE) [11][12] is an open-source programming bundle used to program the Arduino utilizing a general programming language like C and C++ through sequential correspondence utilizing a PC. The Arduino utilized with the Arduino Ethernet safeguard [13] can be utilized to associate the Arduino to the Internet.

2.2 INPUT DEVICES

2.1. Wired Binary Switch Sensor-Photodiode

The constantly cycle assumes a significant part in deciding patterns in climate. Changes in the term of constantly show advances in seasons. Observing of the constantly cycle can likewise be utilized to control road lighting consequently. This is an energy effective framework that can be utilized in shrewd city projects. For this situation, a photodiode is utilized to demonstrate whether it is day or night. The photodiode yield is associated to an advanced I/O pin of the regulator. It goes about as a parallel switch which detects whether it is day or night. The circuit for the photodiode is displayed in Fig.2. The potentiometer R2 is utilized to set an edge voltage to such an extent that the two particular conditions of the photodiode yield demonstrate whether it is day or night. The functional intensifier based comparator gives a paired yield contingent upon the sunlight conditions and sends it to the control unit. Because of continuous variety in daylight and overcast cover, it could be challenging to set a fixed edge. The occasional varieties can be consolidated utilizing the potentiometer. For the day to day varieties, the temperature and moistness can be utilized alongside the photodiode result to decide whether it is day or night. This straightforward circuit can be utilized actually in down to earth applications.Rather than the photodiode, light ward resistors (LDR) can be utilized to investigate more parts of the day furthermore, night cycle with more prominent precision. How much insolation got can be observed through the utilization of different sensors like LDR. It can assist with recognizing whether the weather conditions is radiant, overcast, clear, and so on. Further, investigation of insolation readings can have critical significance for sun powered energy applications.

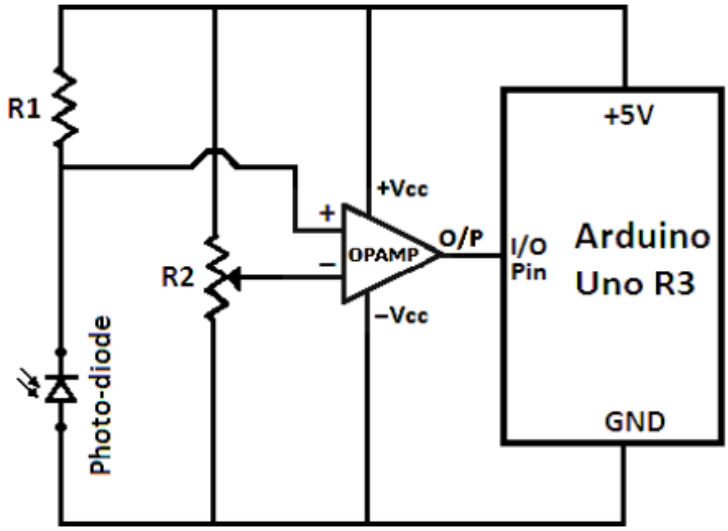

Fig 2: Photodiode based Day-Night Sensing Circuit

Wired Analog Sensor-Humidity Sensor

Stickiness shows the dampness content in air. As the air gets soaked with dampness, precipitation may happen. Perception and examination of the mugginess readings in a district throughout quite a while can serve to comprehend and in this way foresee precipitation designs. Outright mugginess is the substance of water in air in gm/m3 . Relative moistness is communicated in rate as the proportion of outright moistness to the most extreme outright stickiness conceivable at that temperature. When the general moistness increments, either because of increment in water content or a decrease in temperature, the water content in the air gathers to give precipitation. Along these lines, observing relative dampness can serve to break down and at last foresee precipitation designs.

For this situation, the simple stickiness sensor SY-HS-220 [14] measures the relative dampness (RH) in rate. The standard attributes of the sensor according to the datasheet [14] are almost straight. In this way, straight relapse examination is proceeded as displayed in Eq. (1) to inexact the attributes to a straight line and empower interjection.

$$V0= (0.0331x\ RH)-0.0115 \quad (1)$$

The in-built ADC of the controller converts the analog voltage input Vo to the digital voltage reading V which is converted to relative humidity (RH) by the control unit as shown in Eqs. (2)-(5).

$$V=(V0/6)x1023 \quad (2)$$

$$RH=(V0+0.0115)/0.0881 \quad (3)$$

$$RH=(Vx0.148)+0.3474 \quad (4)$$

Remote Digital Temperature Sensor

Observing and investigation of temperature readings in a locale throughout quite a while can assist with understanding occasional changes and their examples. Investigation of patterns in temperature variety over many seasons can assist with grasping the effect of an Earth-wide temperature boost furthermore, consequently, environmental change. The temperature and moistness readings together can serve to ultimately foresee precipitation designs more precisely than by utilizing the stickiness perusing alone. Temperatures may change throughout brief distances and brief time frame spans in a district. In this manner, numerous temperature sensors can be associated remotely, with a focal control unit, over an area to get a temperature map. For this situation, the advanced temperature sensor DS18B20 [15] is utilized with a microcontroller based remote unit. The microcontroller sends the temperature perusing sequentially to the

Xbee [16] module for transmission. The perusing is gotten by the Xbee recipient associated with the Arduino. The circuit for the remote temperature detecting unit is displayed in Fig. 3 also, the association of the Xbee recipient to the Arduino is displayed in Fig. 4.

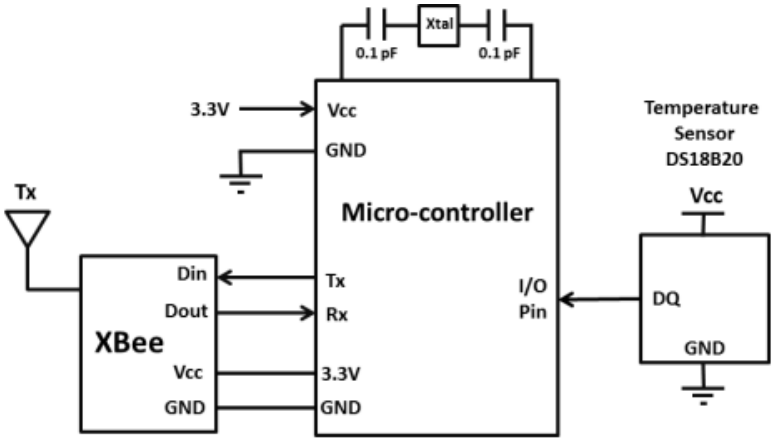

Fig. 3. Wireless Temperature Sensing Unit Circuit

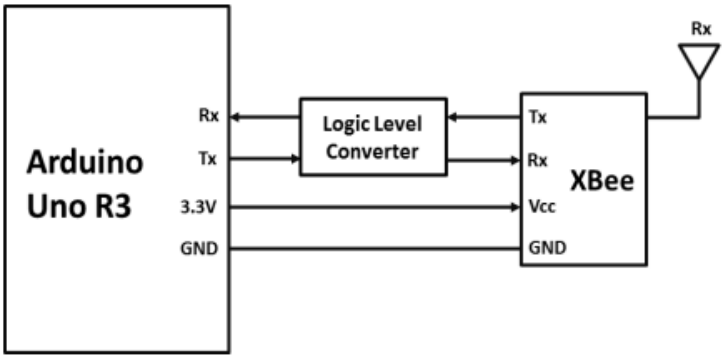

Fig. 4. Connection of Xbee RF module to Arduino

2.3 OUTPUT DEVICES

Contingent upon the info got from the photodiode, for this situation, a light determined by the AC mains is turned on or off utilizing a transfer. Assuming it is day, the light is turned off and assuming it is night, it is turned on. The hand-off circuit for the result light is displayed in Fig. 5. To forestall any reverse of weighty current from the AC mains into the exceptionally delicate low power control unit, optical coupling is utilized for electrical segregation between the control unit and the transfer circuit. A diode is utilized with the transfer to hinder the negative sign from comparator. Comparable frameworks can be utilized for energy-effective, mechanized road lighting in brilliant city projects. Essentially, a wide range of sensors can be utilized to control different result gadgets for various applications. For instance, temperature can be utilized to control fans, forced air systems and radiators. This can save a lot of energy as these are all high power-consuming gadgets. Movement sensors can be utilized to recognize action in a room. The lights in the room can be turned on provided that the presence of a individual is recognized. Sensors that action the dampnesscontent in soil can be utilized to control the computerizedwater system frameworks. Along these lines, water can be provided to theplants just when required and in fittingamount. This will preserve water and help to battlethe impacts of dry spell. IoT can in this way, help to assemblechoice emotionally supportive networks for accuracy horticulturewhich is a progressive idea in itself.

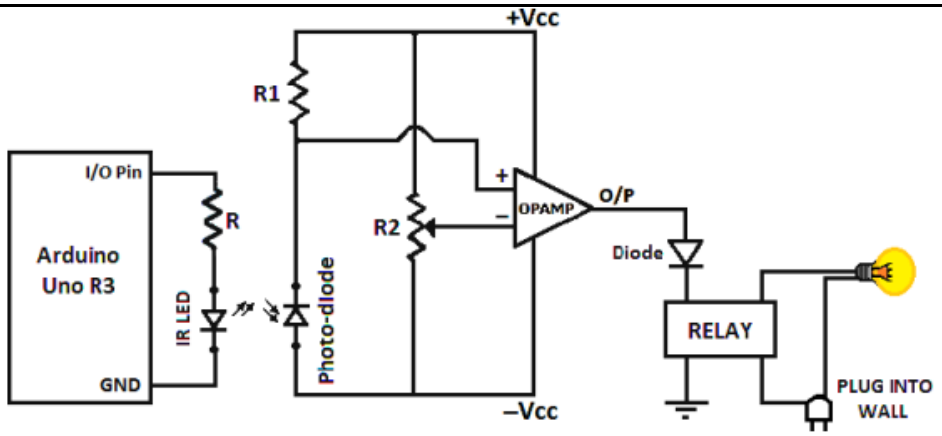

Fig. 5. Relay Circuit for Output Lamp

2.4 Web MECHANISM

The Twitter API is a RSS channel. Rich Site Summary (RSS) gives a class of web channel designs that can be utilized to distribute successive updates in data. The information can likewise be made accessible to the general public whenever required. Subsequently, Twitter is an advantageous Application Program Interface (API) to transfer the climate boundaries. The gathered sensor information is transferred on an approved Twitter account. Twitter utilizes the HTTP Secure Protocol which utilizes the SSL encryption layer alongside HTTP. The Arduino executes the application layer elements of the IoT gadget though the vehicle layer, organization layer, connect layer and actual layer of the gadget are carried out in the Ethernet safeguard. Consequently, there is no arrangement for obliging encryption layer usefulness in this IoT gadget. Subsequently, the Arduino can't tweet straightforwardly. It sends the message to an intermediary server which runs on the straightforward HTTP application layer convention without SSL encryption. The intermediary server then, at that point, tweets to the Twitter account. Nonetheless, the correspondence of the Arduino over the Internet in this case is unstable because of the absence of encryption layer. Access is approved by the OAuth [18] token created for the Twitter account. OAuth produces a token for the given client qualifications which for this situation are the login subtleties for the Twitter account. This token is utilized to give Arduino admittance to the Twitter account, with the authorization of the record holder, without sharing client accreditations. Subsequently, the Arduino doesn't have to indicate the client name and secret key each time it requirements to tweet. For this situation, the Arduino is associated with the web utilizing the Arduino Ethernet safeguard [13]. The Ethernet association can be instated either by powerfully getting the IP address from a DHCP server or physically arranging the IP address, subnet, default passage and DNS. The Arduino Tweet Library [17] is utilized to send tweets utilizing the Arduino. The information gets time-stepped as each tweet is time-stepped by Twitter. Twitter rejects another tweet assuming it is equivalent to the final remaining one andgives a 403 Forbidden status code blunder. Despite the fact that the tweet demand is legitimate, the Twitter server declines to answer it. To defeat this, a counter is augmented for each tweet and sent alongside the sensor information in the event that sensor information doesn't change. A fruitful tweet gives a 200 OK status code. The OAuth token and the information to be transferred are inserted in the URL.

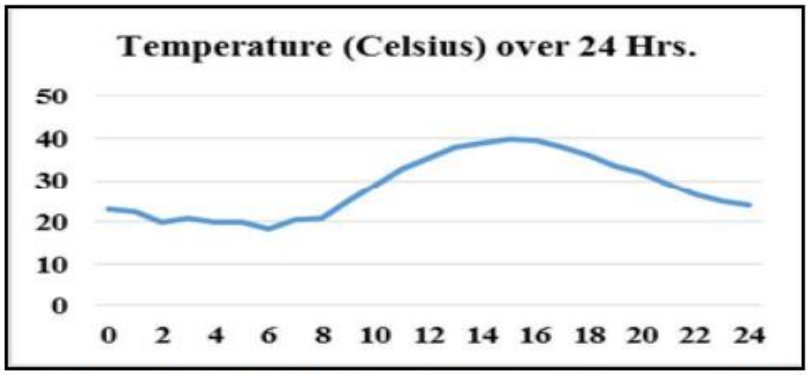

Fig. 6. Graph for Variation of Temperature over 24 hrs.

By documenting the tweets as a CSV record, it tends to be conceivable to address the information graphically for better comprehension of patterns from the information. By utilizing more complex cloud stages for transferring the sensor information, it tends to be feasible to do this examination in continuous. An example chart for temperature variety is displayed in Fig. 6. The charts of constantly cycle can demonstrate occasional varieties in the length of day also, night. A rising pattern in mugginess can demonstrate a chance of precipitation. Patterns in temperature change can demonstrate occasional varieties. Whenever saw throughout quite a while, temperature varieties can assist with recognizing the pace of worldwide warming.

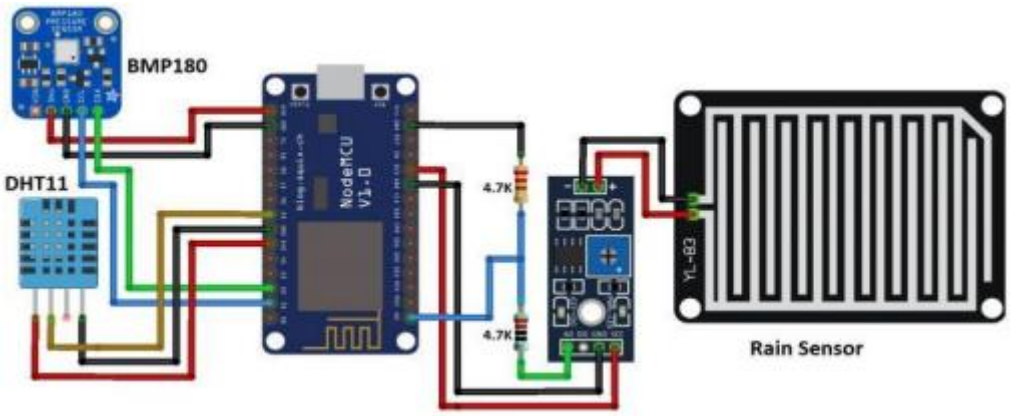

Fig 7. Circuit diagram of the weather monitoring system

2.5 DESCRIPTION OF ALGORITHM

After initialization of libraries and I/O pins, the photodiode input, temperature input and humidity input are read by the control unit. If the photodiode input is ‘high’, the relay output driving the output lamp is ‘low’ and vice versa. The photodiode input is sampled every second to control the output lamp whereas the temperature and humidity readings are taken every minute. Every sixtieth photodiode reading and every temperature and humidity reading are inserted into the format of the HTTP POST request URL for sending a tweet and thus the data is uploaded on Twitter.

3. RESULTS

The climate boundaries, transferred by the gadget, are gotten as updates to devotees of the Twitter account. The information can be gotten to from anyplace with the guide of an Internet empowered gadget like PC, cell phone, tablet, PC and so forth. Assuming that the information is made public, it very well may be gotten to via looking for the Twitter handle. The transferred time-stepped climate information is found in the screen captures displayed in following fig. shows temperature variety because of the presence of warming components close to the temperature sensor

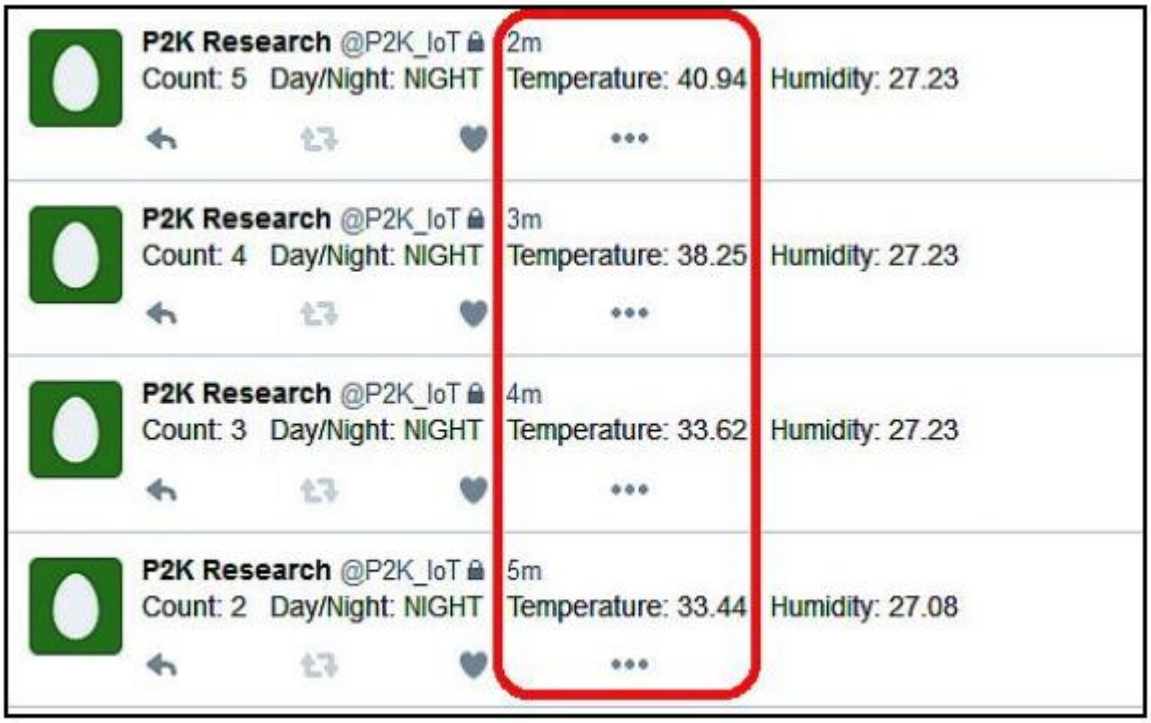

Fig 8: Event of temperature varieties in tweets due to warming more than 4 minutes

4. CONCLUSION

The IoT gadget in light of the introduced plan can be used to remotely screen climate boundaries like light, temperature and dampness. The information can be put away on the web, which can be utilized to figure climate also, ultimately examine environment designs, as well concerning other meteorological purposes. The framework utilizes a great mix of simple and computerized sensors in wired and remote methods of activity. Accordingly, a proof of idea for an Internet of Things gadget for a remote weather conditions checking framework has been laid out. This fundamental plan can be expanded and changed appropriately to acknowledge other IoT applications as well.

REFERENCES

[1] CharalamposDoukas, “Building Internet of Things with the Arduino”, CreateSpace Publications, 2012

[2] Shifeng Fang et al., "An Integrated System for Regional Environmental Monitoring and Management Based on Internet of Things," , IEEE Transactions on Industrial Informatics , vol.10, no.2, pp.1596-1605, May 2014

[3] Twitter, https://twitter.com

[4] Arduino Uno R3 Datasheet, Available: http://arduino.cc/en/Main/arduinoBoardUno

[5] M. Ibrahim, A. Elgamri, S. Babiker and A. Mohamed, "Internet of things based smart environmental monitoring using the Raspberry-Pi computer," Fifth International Conference on Digital Information Processing and Communications (ICDIPC), 2015, Sierre, 2015, pp. 159- 164.

[6] Raspberry Pi - Teach, Learn, and Make with Raspberry Pi, Available: http://www.raspberrypi.org/

[7] S. R. Mohana and H. V. Ravish Aradhya, "Remote monitoring of heart rate and music to tune the heart rate," Global Conference on Communication Technologies (GCCT), 2015, Thuckalay, 2015, pp. 678-681.

[8] M. Suresh, P. Saravana Kumar and T. V. P. Sundararajan, "IoT Based Airport Parking System," International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), 2015, Coimbatore, 2015, pp. 1-5.

[9] A. Leone, G. Rescio and P. Siciliano, "An open NFCbased platform for vital signs monitoring," AISEM Annual Conference, 2015 XVIII, Trento, 2015, pp. 1-4.

[10] Kulkarni, P.H.; Kute, P.D., "IoT Based Data Processing for Automated Industrial Meter Reader using Raspberry Pi," presented at the International Conference on Internet of Things and Applications, Pune, India, 2016

[11] Simon Monk, "Programming Arduino- Getting Started with Sketches", Tata McGraw Hill Publications, 2012

[12] Arduino, Available: http://www.arduino.cc/

[13] Arduino Ethernet Shield W5100Datasheet, Available: http://arduino.cc/en/Main/arduinoEthernetShield

[14] Analog Humidity Sensor SY-HS-220 Datasheet, Available: www.tme.eu/en/Document/d6b8c08f190d39dd5204c1edb 9f c2516/\\sy-hs-220.pdf

[15] Digital Temperature Sensor DS18B20 Datasheet, Available: http://datasheets.maximintegrated.com/en/ds/DS18B20.pdf

[16] Xbee RF Module Datasheet, Available: www.digi.com/pdf/ds_xbeemultipointmodules.pdf

[17] Tweet Library for Arduino, Available: https://arduinotweet.appspot.com/

[18] OAuth 2.0- OAuth, Available: http://oauth.net/2/

[19] Top 50 Internet of Things Applications, Available: http://www.libelium.com/top_50_iot_sensor_applications_ranking/

[20] M. A. Razzaque, M. Milojevic-Jevric, A. Palade and S. Clarke, "Middleware for Internet of Things: A Survey," in IEEE Internet of Things Journal, vol. 3, no. 1, pp. 70-95, Feb. 2016

[21] Mary Nsabagwaa, Maximus Byamukamab, Emmanuel Kondelaa, "Towards a robust and affordable Automatic Weather Station ", journal homepage: www.elsevier.com/locate/deveng.

[22] Ravi Kishore Kodali and Snehashish Mandal "IoT Based Weather Station" 2016 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT) 978-1-5090- 5240-0/16/$31.00, IEEE, (2016)

[23] Ravi Kishore Kodali and Archana Sahu "An IoT based Weather Information Prototype Using WeMos" 2016 2nd International Conference on Contemporary Computing and Informatics (ic3i), 978-1-5090-5256-1/16/$31.00, IEEE, (2016)

[24] Zi-Qi Huang, Ying-Chih Chen and Chih-Yu Wen, "Real-Time Weather Monitoring and Prediction Using City Buses and Machine Learning", Vols. 3 to 21 Published 10 September (2020)

[25] KavyaLadi, A V S N Manoj, G V N Deepak, "IOT Based Weather Reporting System to Find Dynamic Climatic Parameters", International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS-2017)

[26] P. Susmitha, G. Sowmyabala "Design and Implementation of Weather Monitoring and Controlling System", International Journal of Computer Applications (0975 – 8887) Volume 97– No.3, (July 2014).

[27] Tanmay Parashar1, Shobhit Gahlot2, Akash Godbole3, Y.B. Thakare4 "Weather Monitoring System Using Wi-Fi", (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2015): 78.96, 2015

[28] Nutant Sabharwal, Rajesh Kumar, Abhishek Thakur, Jitender Sharma "A LOW-COST ZIGBEE BASED AUTOMATIC WIRELESS WEATHER STATION WITH GUI AND WEB HOSTING FACILITY" e-ISSN: 1694-2310 | p-ISSN: 1694-2426, Vol. 1, Spl. Issue 2 (May 2014)

[29] M. Prasanna, M. Iyapparaja, M. Vinothkumar, B Ramamurthy, S.S. Manivannan," An Intelligent Weather Monitoring System using Internet of Things", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue4, November (2019)

[30] MirceaPopa and CatalinIapa "Embedded Weather Station with Remote Wireless Control", 19th Telecommunications forum TELFOR 2011 Serbia, Belgrade, November 22-24, 2011, 978-1-4577-1500-6/11/$26.00, IEEE, 2011