

# A review of weather conditions monitoring system based on iot

Rasoul Ali Mahdi<sup>1\*</sup>, Hadi A. Hamed<sup>2</sup> and Haider K. Latif<sup>3</sup>

<sup>1,3</sup>Al-Awsat Technical University, Karbala,Iraq

<sup>2</sup>AL-Hussain University College, Babylon,Iraq

**Abstract:** Continually varying climate settings are controlled by weather adjusting schemes. These sensor units gather information that is utilized for climate recording, monitor surrounding setting, and work out varies in a certain spot. In fact, examination of changing climatic and surrounding settings in a certain zone, as well as the investigation of environment, benefit extraordinarily from this information. Likewise, various implementations, including horticulture, geography, mining, and climate expectation model turn of events, could profit from the gathered information and investigation. An Internet of Things (IOT)- based climate measurement framework includes making a live climate surveillance framework that might follow area heat, moisture, barometric pressure, and precipitation stage. In this study various kinds of climate measurement frameworks are checked on and the contributions of researchers in this field will be reviewed by examining the latest scientific articles and studies in the field of climate controlling systems. The technologies used will be identified and their advantages, disadvantages, determinants and problems facing their implementation will be studied to reach a comprehensive vision to know the best technologies that can be applied in a weather measurement system based on the Internet of Things (IOT).

## 1 Introduction

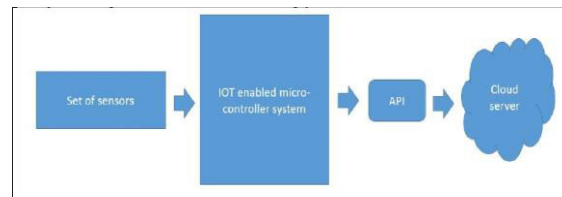
Today, monitor one's surroundings including the climate, is a major and vital concern. Numerous related studies on the evolution of the living environment have produced a number of web-based measurement systems. However, because of the complexity of information systems, it is now more difficult to fully promote and convey information to others, as adequate training is demanded to achieve consistency and maintain the regularity and security of this information. Controlling the climate tremendously affects everybody's life. The effect of the condition of the climate makes various troubles in different businesses, including farming, production, construction, and others. Nonetheless, the assessed influence basically influences production and farming. In some countries, the financial strength relies intensely upon farming. The farming or also called agriculture, contributes about a fourth of the countries' gross domestic product. The idea of shrewd farming has been up for conversation around the world as of late. Utilizing at least factors prompts a prevalent outcome, as per the brilliant term. It lessens how much land, water, time, and new logical and innovative advances that are utilized to further develop crops. Figure 1 shows a schematic diagram of IOT based climate conditioning model [1-4]. Before the gather, there are different stages to the cultivating system in farming, and the climate biggestly affects these stages. The locale that encounters downpour most often. It is assumed that it is found near a bumpy district, hence downpour is a typical event there. The cultivating issue emerges because of this circumstance's extreme precipitation. Prior to planting or harvesting the yields in this present circumstance, a climate figure is a pivotal variable.

The consistently Climate variables and climatic setting are monitored through the use of climate observations frameworks. These detector units gather information that is utilized to record the climate with watching surrounding changes in a particular region. The examination of moving climatic and surrounding circumstances in a particular region, also the investigation of the planet, benefits significantly from such information.

Furthermore, various implementations, including farming, geology, mining, and the advancement of climate determining models, can utilize the assembled information and examination.

\*Corresponding author: [rasoul.ali.tcm.15@student.atu.edu.iq](mailto:rasoul.ali.tcm.15@student.atu.edu.iq)

This undertaking includes the construction of a direct climate controlling framework that can follow an area's heat, moisture, atmospheric pressure, and precipitation level. These set of detector units gathers the surrounding information and sends it to the IOT-based miniature regulator framework. The miniature regulator then, at that point, sends these information to the cloud server utilizing the programming interface [5,6]



**Fig1.** Block diagram of Fack news recognition model [1-4].

Present-day innovations in innovation primarily center around controlling and measurement various gadgets remotely over the internet to such an extent that the internet goes about as a mechanism for correspondance between all gadgets. The vast majority of this innovation is centered around productive measurement and controlling of various. A proficient surrounding surveillance framework is expected to monitor and evaluate the climate setting in the event of surpassing the endorsed level of boundaries (e.g., clamor, CO, and radiation levels) and for social occasion information for investigation purposes (measure of precipitation, windspeed, and so on.). A framework is viewed as a smart framework when the gadget outfitted with detectors, microcontrollers, and different software implementations turns into a self-safeguarding and self-surveillance framework. The new climate changes have expanded the significance of surrounding measurement. The ongoing advances in the area of innovation and Financial strength altogether affect the climate and have prompted serious worries with respect to pollution and climate change. The Intergovernmental Panel on Climate Change (IPCC) in the report affirms that human exercises are affecting the climate framework, with late changes that are exceptional over centuries many years [4,8]. In this unique situation, surrounding measurement addresses a central instrument for social occasion important data about the biological system, prompting new information and understanding and eventually transformation and moderation activities that address the debasement of the biosphere. Occasion Discovery and Spatial Cycle Assessment are the two classifications into which implementations are ordered. At first, the detector gadgets are sent in the climate to distinguish the boundaries (e.g., Heat, Moisture, Pressure, LDR, noise, CO and radiation levels, and so on) while the information procurement, calculation, and controlling activity (e.g., the varieties in the noise and CO levels concerning the evaluated levels). Detector gadgets are situated at various areas to gather the information to figure the way of behaving of a specific area of interest. The fundamental point of this research is to plan and execute a resourceful measurement framework through which the expected boundaries are monitored remotely utilizing the internet and the information accumulated from the gadgets are put away in the cloud and to extend the predictable pattern on the internet browser. An answer for measurement heat and CO levels i.e., any boundary esteem passing its boundary esteem ranges, for instance CO levels in air in a specific region extremely the ordinary levels and so on, in the environment utilizing remote implanted registering framework is recommended in this research. The arrangement likewise gives a canny remote surveillance to a specific area of interest. In this research we likewise current consequences of gathered or detected information as for the typical or determined scopes of specific boundaries. The implanted framework is a reconciliation of detector gadgets, remote correspondance which empowers the client to get to the different boundaries and store the information in cloud from a distance [8-10]. One of the most important problems in climate control and surveillance systems is the problem of planning the implementation of the Internet of Things (IoT) infrastructure. Proper planning and design is the basis for reducing its difficulty and complexity and to provide capabilities and mechanisms to restore use of the system at any time with high efficiency. Figure 2 displays a block diagram of a data-collector oriented IOT based approach architecture [9,10].

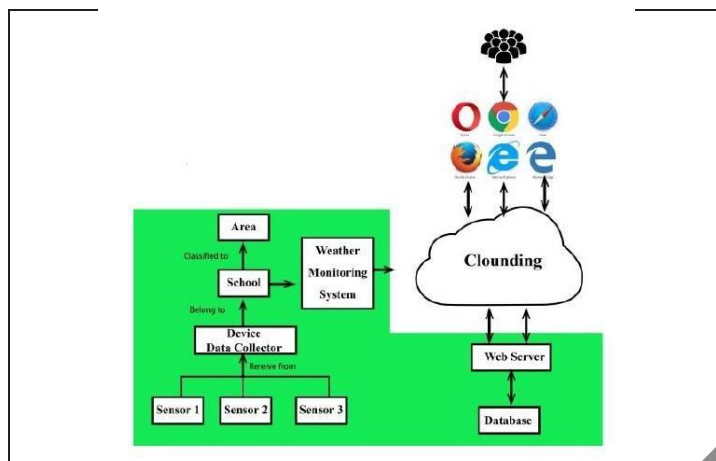


Fig 2. Block diagram of a data-collector oriented IOT based approach architecture [9,10].

Next, the IOT weather monitoring model block diagram is presented in Figure 3 [11,12].

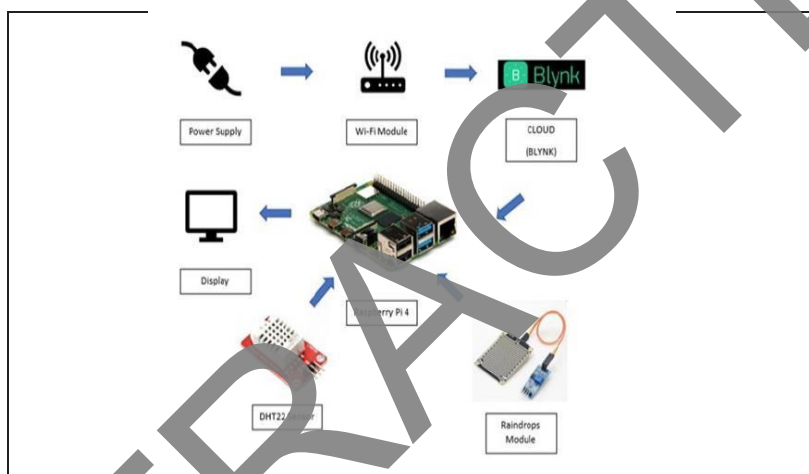


Fig 3. The IOT weather monitoring model block diagram [11,12].

Also, the flowchart of the IoT Weather Monitoring Framework is displayed in Figure 4 [13-16].

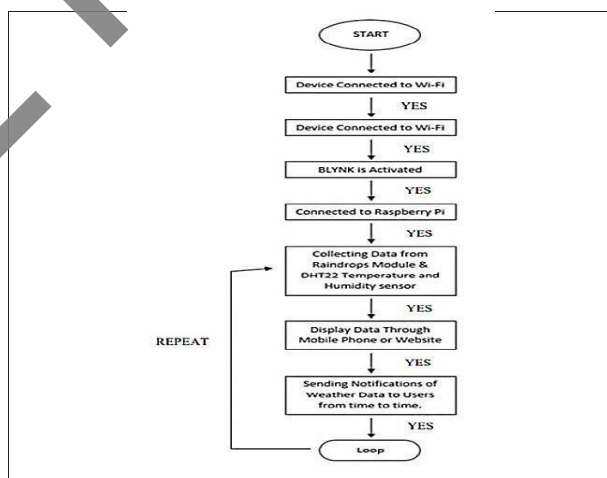


Fig 4. Flow chart of typical IOT based climate monitoring model [13-16].

It begins by turning on the gadget, and it will automatically look for an organization association. At the point when the gadget has been associated with an organization, Blynk will be expected to enact and begin matching with a similar organization association. Subsequently, Blynk will then associate with the Raspberry Pi and begin communicating information from the Raspberry Pi to Blynk. The raindrop module and DHT22 heat and moisture detector will begin gathering information on the climate setting and will send it to the Raspberry Pi. It will then be shown on cell phones or any LCD that is picked [8-12]. The gadget will continue to send notices about the climate setting every once in a while. This cycle will continue onward until the client closes down the gadget [13-20].

## 2 Literature Survey

This part will review recent sources and investigation related to the subject of surveillance and measurement climate setting based on the Internet of Things. Important relevant articles and studies will also be reviewed to determine the extent to which researchers contribute to this topic within the modern scientific framework and identify the most important technologies, indicating their advantages and obstacles, and proposals to overcome problems and provide appropriate and efficient solutions to them [11-62].

In [11], the creator recommended a dependable and savvy automatic climate station. In this article, the creator makes sense of how each climate outrageous occasion makes it more challenging to foresee the climate, which harms the two lives and property. To work on climate estimate capacities and fortify protection from the impacts of unfavorable climate report setting, the efficiency of climate information is part of the key troubles. The creator examines how a few nations, containing Uganda, The huge cost of making autonomous climate setting incorporates the restricted accessibility of climate measurement. Those qualified for the limited subsidizing incorporate the communal climatic utilities of every provincial. The creator early resolves the cases in such framework prior to trying it. The creator suggested a remote detector system-relied automated climate measurement site. The creator expects to make three distinct automated climate station (AWS) models. As indicated by the prerequisite with age, the creator for such investigation evaluates the original AWS scheme to upgrade the alternative. To have an Automated Climate Site, the creator recommends working on the nonfunctional prerequisites, like energy consumption, information accuracy, trustworthiness, and information move. To make a solid and practical Automated Weather Station (AWS), the non-useful prerequisites were killed along expense decrease. Subsequently, the suggested work will empower emerging countries like Uganda to buy the AWS in a proper unit sum to improve climate estimating.

In [12], the authors introduced an Internet of Things-based climate surveillance framework. In this review, sensing units might be utilized to obtain the circulating boundary. The LDR detector is used by the creator to range a few boundaries like moisture, heat, pressure, with downpour esteem. The framework additionally utilizes the heat model to decide the condensation mark esteem. The worth of a specific district, room, or area could be resolved utilizing the heat detector. The creator's utilization of the luminous strength is composed conceivable by the LDR detector. At the point when the worth of the detecting boundaries, like heat, moisture, stress, luminous strength, with downpour esteem, surpasses a specific edge, the writer in such study utilized an additional usefulness of climate surveillance as a SMS ready framework. The creator likewise incorporates a framework for email and tweet post cautions. The creator integrates different sensing units and a hub MCU 8266 into this framework. In the article [13], the creator delineates a minimal expense living climate measurement framework with an OLED show, offers the various businesses such that, the Internet of Things (IoT) has produced innovative framework parts. The creator examined a vacant-modern, historic framework, that measures the ongoing climate case. Hence, eachone, including farmers, business proprietors, individuals who labor in day to day existence, and understudies, benefits extraordinarily from climate measurement. Hence, by making a live climate surveillance framework, the creator likewise diminished the trouble for production and farmers.

The creator of [14] suggested a framework that tracks and estimates climate setting, permitting individuals to make arrangements for their day to day routines. This action became helpful in both farming and production, across all areas. The creator utilizes two stages of the climate administration framework to monitor and foresee climate data. To give a climate detailing framework in sites and transports in real-time, they consolidated the information through the sensing units, transport portability, and profound learning innovation. The erosion model is utilized for climate anticipating. The work incorporates the strength of nearby data handling in view of detecting estimations from vehicles like transports. As per the creator, stage 1 includes preparing the multifacet discernment structure, large haul storage, with climate detecting, that is trailed by confirmation utilizing test-climate heat, moisture, and pneumatic force information. The preparation is put to use in the second phase to

become familiar with the time series climatic information. The creator contrasted the real climate information and the climate information projected by the climate security head and focal Baeuro of Taichung perception framework to decide whether the information were precise or not and to survey the framework's exhibition. At last, the creator examines how the recommended approach performs reliably while surveillance the climate.

Along the preparation scheme, this system likewise recommended a single-day climate estimate or expectation. At long last, the creator shows that this framework utilizes transport data the board to introduce a real-time climate measurement and expectation framework. The creator is an illustration of four key parts.

In this examination work, the creator [15] demonstrates the way that the climate might be controled against the guide of IoT innovation by carrying out an IoT-based weather measurement framework. Also, this uncover data around the impacts of surrounding alternation. Individuals might be mindful of variations in the environment on account of this undertaking. It provides outcomes which are exact and powerful, and it utilizes the multitude strategy to additional increment efficiency. Thus, the creator's objective in this venture is to utilize IoT to make a climate measurement framework. This venture utilizes equipment and programming, simplifying it to carry out. The creator of the development utilizes a different detector to accumulate environment data those are next saved in the network server. The implemented network site is every now and again utilized for Internet of things programs as such stockpiling. Furthermore, utilizing a Programming interface key, it extricates each of the climate information from the cloud stockpiling region and transfers it to the Android versatile implementation. Downpour detector is gadgets which might identify rainfall. Thus, and later to the epidemic has uncovered the beads on the strips, the potential is considered. The water is an unfortunate guide, with the detector acts as a contradicting obstruction, producing a course status. Later the potential has been estimated, the course takes the outcomes. A device called potentiometer is utilized to gauge the potential; also a Comparator of LM393 is utilized in the framework to change the simple sign over completely to the computerized signal. At the point that the energy source framework is noticed and there are no rain weeps on the detector, the advanced result is huge, as well as the drove forces on. Moreover, the detector indicates that the advanced outcome is effectively little whenever the detector has dampness on the detector dish. In this situation, three sensing units, remembering thermistors (TC) with an IC for the rear of the sensing units, might be utilized to gauge moisture. The moisture part employed for estimation has two cathodes. The regulator is a Hub MCU. Commonly, the Hub MCU is used in IoT programs. Such case was reported utilizing the Arduino IDE. For robotics, LUA is utilized as a prearranging software. On the ESP8266 WiFi module, NodeMCU is controlled. Utilization of this Android STUDIO was made by Google designers. Thus, such implementation will likely work on handling. The execution of a standard implementation will show the spilling of information through thing zone utilizing Android studio. The climate could be gotten against such cell phone implementation Condition might be watched out for. The implementation has been planned and is presently cloud-native, showing heat, moisture, intensity, and precipitation. To move our information from the Thing speak site to the Android cell phone, the creator gave a Programming interface Key.

Plan and execution of a climate measurement and controlling framework is the subject of this study [16]. The creator zeroed in on the activity of the climate surveillance framework in this venture. The creator asserts that climate surveillance frameworks are critical to our day to day routines. In this way, gathering information on limited variations in the surrounding is fundamental. Actually, there are sure dangers begun in the modern area. In the primary frameworks, electromechanical with automated equipment are essential for the production. Furthermore, the framework has a few defects, containing an absence of tetanus, the requirement for personal connection, related view obstacles, with solidness necessities. Subsequently, a wireless surveillance framework is expected to resolve such case, also the principal aim of such framework is to produce a standalone measured climate controlling framework which worked in wireless adjustment against correspondence capacities to catch and impart the climatic boundaries. Accordingly, watching out for the climate is essential. The creator of this examination concentrate on utilizes an installed framework to develop a climate detailing and surveillance framework that licenses climate measurement. This sort of framework utilizes a couple of sensing units to distinguish things like moisture, downpour, heat, and gas. The principal framework is a LPC1768 microcontroller (ARM9), which interfaces with every one of the sensing units and accumulates climate-related information like heat, moisture, pressure, and so forth. In the wake of social event every one of the information, utilize sequential correspondance to convey it to LABVIEW. Such module stored the particulars, using the Worldwide Framework guide for Portable correspondance model, data along the succeed bookkeeping sheet could be transmitted as SMS to a cell phone. Such framework utilizes massive hardware worked about the LPC1768(ARM) microcontroller. In such undertaking, an

IDE-relied software written in implanted C is utilized. Programs are stacked towards a microcontroller utilizing JTAG. The National Instruments LABVIEW stage establishes the climate for a visible automated software. "G" is the noun of the realistic. A sequential correspondance strategy might be utilized in LABVIEW to get information entering through gadgets. The perusing shows different information alongside a sign, for example, metering, and so on. The Succeed record can show the LABVIEW yield from review a Succeed document, tracking down the record in the envelope, and changing the worth. Hence, this framework watches out for the surrounding boundary thusly. The installed controlled detector has proactively demonstrated to be reliable.

The utilization of a WFI unit to make a climate measurement framework is shrouded in article [17]. Wi-Fi is utilized to play out the cycle by the climate controlling framework. A sender segment with a getting segment are each instant in the framework. The Wi-Fi module, the regulator, and a few sensing units are completely situated in the sending region. The web server, switch, site, and so forth are completely situated in the getting area. As per the writer, various sensing units, including sensing units for strength as well as moisture, read the circling heat, strength, and moisture thusly. This strategy could be utilized by the downpour check detector. In such technique, adjusted instants counting could be unfilled in the wake of being loaded up with precipitation. A definitive measure of downpour is determined by duplicating the unfilled single tip by 0.02 millimeters later the rain has been filled to the adjusted imprint. The breeze check is utilized to quantify the breeze's heading with velocity. It is important for the mark condition to obtain an exact breeze speed estimation. The Schmitt trigger, a bi-stable circuit, achieves the result through the sign molding framework, that incorporates an optocoupler. At the point when the potential entrance esteem ascends past single edge in such system, the result ascends to a consistently expanding utmost extreme and tumbles to the mid 0 when the potential entrance esteem drops beneath alternative edge. The D1 regulator acknowledges with operations yield along every detector in a foreordained organization. Such qualities are shipped off the essential cloud over Wi-Fi. The essential cloud keeps up with each of the detected information values, courses them, and updates the site persistently against them. 10 sec invigorate stretches. The MySQL inquiry software is utilized to fabricate the information base. The data on the site is shown utilizing the PHP prearranging software.

### 2.1. Remote Sensor Network Model Relied

As indicated by Ashenafi and Haghani (2014) [31], Wireless Sensor Networks (WSNs) incorporate different sensing units dispersed spatially, with the limit with respect to correspondance, handling, and figuring. The information is detected and communicated to the base station routinely. Here, in a real-time way, information is handled and made due. One suggested structure overcomes the above limitation by organizing of WSN base for various climate progresses using virtual sensing units and overlay thoughts. Really taking a look at climate data and providing SaaS and relational association upheaval alerts considering decision ID3 model that provides server approval using immune cover. Comparative task produces a provisional synopsis of WSN using the Internet of irritates relied on the PARASENSE design. A decent game design is composed for transmitting ceaseless implementations as well as for conveying them.

### 2.2. Satellite Model Relied

As indicated by Kalsi (2008) [62], Astroid data is continuously being used as a piece of association using usual astrology discernments in the succinct examination with customary weather check to concentrate information. CanSat is a range propagation of the framework, formation, as well as hustle of a certified asteroid. It is drawn by insignificant employing efforts, such that, the weather noticing is the utilize of knowledge against improvement of the state prediction for the weather for a provided zone. The CanSat gathered might be sender also utilized to monitor region weather for a reach, in a saving access. The creators have made sense of our study in such article, that the weather asteroid is a sort of asteroid that is utilized to view the conditions and the Earth atmosphere. Climate asteroid images are consistently accommodating in assurance the impulsive dust server.

### 2.3. Microcontroller Model Relied

In 2015, Susmithan and Sowmyabala [52], with their review, guarantee that the fundamental place of a task relied on the microprocessor is to make an embedded structure to design a wind-really looking

at system which permits the weather boundaries opinion in an production. Such sort of task incorporates various sensing units like Gas sensing units, heat sensing units, and moistness sensing units such that have seen against the utilization of ARM 9 LPC1768 microprocessors. The accompanying structure uses a complicated circuit created using ARM 9 processing unit. Inserted C writing computer softwares is employed. Booking is finished with the utilization of JTAG in relationship with the ARM 9 processing unit.

#### **2.4. Arduino Model Relied**

In 2015, Karthik and SurajThapa, [34], and along a particular system, it might normally assemble the information about viscosity with heat. During this structure, creators could normally accumulate the information about stickiness and heat. The focal points are taken care of in a database and according to present and past data creators could convey the results graphically in the structure. **vi. GSM Model Relied**

In 2014, Lo Conti, et. al., [37]. A GSM-relied schemes, a contraption for progressing weather perception is shown to cover the consistent heat, surroundingweight, relative soddenness, and air's condensation drop heat during such scheme that employes straightforward with high level sections. Digitized signs are gotten along simple signs and the tabled data is modified by the software intended for showing easy to use results concerning of strength on a showcase.

#### **2.5. Radar Model Relied**

In 2015, Nisha et. Al., [43]. A radar-relied models, the makers presented a strategy which facilitates each of the data supplies to provide vital with organized weather radar. The ZIGBEE relied model has been employed to make detector connections against weather station measurement model without personal intervention, using remote ZigBee Innovation. Zigbee is the latest far off weather actually looking at technique. The past checking structures of the climate measurement model were manual at that time.

#### **2.6. Forecast Models Relied**

In 2008, Mettlach et. al, [40], a forecast based system has been suggested a strategy for measurement transitory weather setting based on spatial with geographical semantics sound multi-specialty. In such, a showing of a people recognition system incl is provided to work on the system efficiency, with the authenticity of data gathered utilizing customary sensing units is asserted. Also, Mattlach et. al. evaluated the traditional weather fleet as a resource of tropospheric measurement. The signal space, that each NDBC weather drifts hourly regularly record. It consists a ton of information regarding the beginning stage, aspect, with expression of ocean storms. This assessments are conveyed through essential accelerometer units starting along a grown-up, resolved advancement. Trade is alternative technique which would implement as a functional sun-relied noticing equipment of zone weather anticipating. The LYRA data would produce beneficial sun-fueled actually taking a look at information, for specialist space climate presently tossing also examining. Also, in another forecast relied structure, the regulation materiel personality using beginning state instability is useful but underdispersed. Thus, in order to upgrade the enduring aspect standards of uniform, the benchmark association is enhanced using 1) irritated lateral viewpoint restriction setting; or, portrayal botch portrayal using any of 2) problematic dynamic soul backscatter or 3) randomly annoyed definition perchants. multiple-material science with a random dynamic essential backscattering game plan are used in a comparative scheme to address structure medium-scale instability company guess structure using the Climate Examination and Anticipating model.

#### **2.7. Detector Model Relied**

In 2014, a continuous work by, Mittal et. al. [41], planned to perceive the geological goes after sun-based and wind-importance times without any problem. Their system depends upon the remotely worked structure with detecting units, which accumulate weather info and convey estimated traits to the field. The construction is battery operated and is supposed to remain on processing against an distributed life time. Passive identifier place focuses and wrapped locator web are related in environmental verification in a unique report. By strengthen as well as summing an identifier model

and a methodology of conveyed handling, the wrapped locator tender might be gotten to a higher level. The climate station was arranged lately and has a social event of detecting units for assessing wind speed and addressing, wind heat, related wetness, and falling. A squall coupling could continue the condensation gage which allows evaluation of the stacked water with snowfall amidst cold climate days. DCOMP is a sharp model producing a plan to sustain processing on detecting units using relative tunnel fixings and has been really cleaned on utmost recent climatic photographers. This regulation produces DCOMP principally advantageous for wind investigation. Associations with the Moderate Resolution Imaging Spectroradiometer (MODIS) collecting 5 tabled data those employed to explore the DCOMP execution.

Thakur et.al., (2016) [54], in their modern work, air identifier, air bearing locator, dampness, with intensity detecting units are utilized for transmitting actual-instant info on What Talk clouding that could with practically no issue seen and explored by an endorsed individual or maybe publicly open. It uses a Raspberry Pi headway board required before by numerous makers for simple-to-utilize projects. Arm 7 is a useful Microprocessor that is all things considered utilized for movement in various executions with real-time.

## 2.8. Camera Model Relied

In 2016, Shital et. al., [51], have utilized an exceptional of camcorder also programmed multi-picture photogrammetry system, it's by and by possible to take out Digital Elevation Models (DEM) while catching a picture using the camcorder. Thus, by applying such a technique; the design might not be confined to transport path absolutely. Also, it could go directly along the equitable zone. Such recommendation introduced the operation proposals of a programmed photographic perceivability system (for little DPVS), threshold of model, the structure of stuff with automated vapour, at last communicate amidst manager and outside array.

## 2.9. Recent Embedded Construction Review

In 2014, Soundarya, et al [51], communicated that a capable and sleek operating control unit is supposed to endlessly recognize each spillage with the gas level. Moreover, rapid feedback is needed whenever spillage is observed with the estimation model ought to provide additional spillage data that could be utilized in extra handling. The disclosure system consolidates Arduino, a microcontroller wide suitable with ATmega328p joined along the structure, LCD show, GSM and DC motor.

In [26], Devahema et al., (2018), in their review saw that the stage has expanded against periods by bundle of components similar to the extension in people, expanded automobile utilization, mechanization with civilization that achieves hazardous ramifications for human flourishing by clearly impacting strength of people uncovered to it. In IOT relied air infection observation model the wind aspect is estimated along a server of the web utilizing internet and will set off a mindfulness whenever the wind aspect drives down beyond a certain stage, suggests exactly whenever there are adequate proportion of disastrous gases are accessible in the air such as CO<sub>2</sub>, mist, drink, and NH<sub>3</sub>. It would display the wind aspect in PPM on the LCD also on web window using the aim which we might auditor it very simply. MQ135 finder that is the better decision for reconnaissance Air Quality as it could recognizes utmost terrible smokes as well as might check their total unequivocally. The dust capacity might be controlled wherever utilizing PC or convenient. Demonstrating such scheme wherever might moreover set off some device when pollution drives past part of stages, similar it could turn on the exhaustion fan or could transmit anytime as demonstrated by Skillet and Zhu (2018), Buildup, recognized as "airborne remains", suggests compact remains which are drooping in wind (width  $\leq 100 \mu\text{m}$ ). Amid them, dirt having width  $< 2.5 \mu\text{m}$ , recognized as "cool unprocessed material", is implied as PM<sub>2.5</sub>. Right later have taken in by the personal body, PM<sub>2.5</sub> could straight arrive the blood along the lungs with bronchi. Their longterm remain in the alveoli applies an unfriendly outcome on the personal cardiovascular, sensory model, and various organs, addressing a threat to people's prosperity. Along such lines, inside wind affection has transformed into a phenomenal interest.

In [18], Al Ahasan et al., (2018), communicated that in this time wind corruption is part of the essential interest of the nature. Air corruption could compose through anthropogenic or customary supplies. Also, surrounding substances air pollutions like CO, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>2</sub>, and O<sub>3</sub> suspended particulate matter (SPM), repairable suspended particulate matter (RSPM), with heat normal blends (VOCs) unusually influence the prosperity of community. A huge part of the critical modern models and systems in arising countries with utmost made countries modern networks are encountering it. Hence, to cultivate an actual instant wind aspect with deterioration estimation model is essential. We have encouraged an Arduino relied wind deterioration locator that joined a little assessed, lowest cost

locator to an Arduino microprocessor unit. The benefits of the identifier, have a trustworthy sufficiency, fast response recovery and long life features. It is sensible, straightforward, negligible cost and least energy essential gear which is fitting for flexible assessment, also understandable info gathering. It has a handling program prepared to separate, assembled aspect info with huge efficiency.

Husain et al., (2016) [31], in their article a cost successful, minimal, actually sensible Arduino based contraption has been acquainted with auditor air aspect. The apparatus operates by social affair info of measure of unequivocal terrible gases against how much buildup present in the air. Such system might be arranged at any spot and the data can be moved to an Android phone through Bluetooth or basically by connecting the contraption to a PC/PC. Data assembled by the device from better places can be thusly broke down to pursue further decisions and examination about the air aspect state; plus, it could in like manner help concerned individuals with circling back to it.

As demonstrated by Karami et al., (2018) [33], building execution estimation could be confined due to the cost and immovability of hardware and software stages for data acquiring. This article portrays a minimized tireless assessment instrument compartment which gives a strong, successfully extendable, and negligible cost plan for indoor environmental quality (IEQ) observation and execution assessment. Different detecting units — temperature, relative dampness, illuminance, CO<sub>2</sub>, VOC, PM<sub>2.5</sub>, and inhabitation — for IEQ execution assessment are associated with this device stash. Arduino Uno stashes were related with the detecting units for data getting. ZigBee correspondence show was spread out between a XBee device for each Arduino board and a XBee gatherer related with a PC. The toolbox used the open source, expert depended software stage for data correspondence and examination. The data collection system was adjusted against an exact data obtainment card. Tests have been coordinated using the device stash for reviewing IEQ execution in an open PC lab inside a commercial design. Warm comfort, indoor air quality, and lighting execution have been inspected based on accumulated data. The focus on showed relentless quality with energy of the instrument compartment for predictable observation of indoor encompassing aspect.

Alvea et al., (2018) [19], communicated that Evidence shows that Splendid Metropolitan people group are starting to show up in our lives through the sluggish show of the Internet of Things (IoT) perspective. In this degree, swarm identifying emerges as serious areas of strength for a for address encompassing observation, allowing to control air pollution stages in stuffed metropolitan locales in a conveyed, collaborative, humble and correct methodology. Nevertheless, regardless of the way that development is presently available, such surrounding detecting contraptions have not in any case shown up at buyers. In this review, we present an assessment of candidate propels for swarm recognizing structures, close by the necessities for drawing in clients with air estimation limits. Specifically, we start by giving a framework of the most appropriate IoT models and shows. Then, we present the general arrangement of an off-the-rack flexible encompassing identifier prepared to adjust to air quality estimation necessities; we research different gear decisions to make the needed getting unit using quickly available devices, examining the very specific issues related with each decision, likewise opening development open entryways to the extent that encompassing reconnaissance programs. Vijayalakshimi et al. (2016) [58], are of the evaluation that "Real Time Climate Monitoring from Far off Region Using Raspberry pi" recommended a system for Real time climate estimation using Raspberry pi, it measure different climate limits like temperature, light intensity, surrounding pressure, Gas/smoke level using reasonable detecting units cooperated with Raspberry Pi, it uses wireless development to give real time data move. The endeavor oversees arranging an essential, significantly compelling, cost feasible and easy to work Real time climate estimation system. Using a database to raspberry pi this adventure can access from wherever.

Rasal and Jaideep, (2016) [49], in their assessment "Raspberry Pi Based Climate Monitoring System" recommended a system that envisions the limits of climate factors. To realize the continuous climate condition at far off region this system is plan for. Suggested System will imagine and store different climate limits as delivered above with the help of detecting units associated with Raspberry will get all data, SD card on Pi stores the accumulated data as like memory card.

Gonçalo et al. (2015) [29], in a work named "A Sharp Weather Station" presented a smart climate station for gauging different elements of climate. To anticipate and assessment climate factors from wherever. The hardware and software plan of the executed prototype are depicted the gauging execution associated with the three air factors, surrounding pressure, dampness, heat.

Vasantha and Basha, (2016) [57], in a work named "Weather Estimation Using Raspberry Pi Viva Web Execution" suggested a climate estimation system. This system similarly fit for reconnaissance with control of surrounding boundaries like temperature, pressure and dampness. It in like manner revolved around little expense. This system uses Wireless indicator Networks for distinguishing the climate limits close by under administration.

Natanael, et al. (2016), encouraged a negligible cost robotized data getting system for metropolitan regions temperature and dampness reconnaissance based in internet of things. This work conveyed a computerized Data Getting system that bestows the collaboration and interoperability of temperature and dampness detecting units through the internet. Results exhibited that the usage of internet of things chipped away at the sufficiency of automatic decision making for the system.

Solid focuses and Borba (2017) [27]. Plan of Negligible cost Multi Channel Data Acquiring System for Meteorological Execution. A negligible cost multi-channel Data getting system was planned for acquiring temperature, dampness, barometric pressure, elevation and light intensity from the climate and stores the data in a PC for future.

Ojike1 et al (2016) [45]. In this work, a negligible cost six-multipoint temperature data logger was made. It was arranged including LM35 as the finder, and arduino Uno as the data handling part. The response time of the finder apparently was some place in the scope of three and four minutes. The comparative evaluation of temperature data logging system. Hence, the

We might also summarize the most recent important investigation and scientific articles that dealt with the topic of IOT based climate monitoring scheme, as shown in Table 1.

Author	Strategy	Features	Constraints
Siddharthan & Kasiraj, (2016)	Detecting units and Arduino	Location of Harmful Gases utilizing Arduino and GSM Network	<ul style="list-style-type: none"> <li>• No Logger</li> <li>• Climate Measurement Models</li> <li>• Single Sensing Unit</li> <li>• No Logging Scheme</li> </ul>
Vasanthan, and Basha, (2016)	Raspberry Pi Viva Web Execution Climate Estimation Models	Reconnaissance with Raspberry Pi Viva Web Execution. Equipped for observation encompassing parts like intensity, pressure and dampness.	<ul style="list-style-type: none"> <li>• It not be controlled and needs the physical human presence being remotely to take records.</li> <li>• No Gas Receiver</li> <li>• No logging model</li> </ul>
Vasudev Yadav, Akhilesh Shukla et. al., (2016)	GSM,	LPG Gas spillage locator	<ul style="list-style-type: none"> <li>• The constraints of such scheme are that it cannot be remotely controlled and needs the physical personal existence to be to take records.</li> <li>• Unique Gas sensing unit</li> <li>• No Logger</li> <li>• No climate surveillance scheme</li> <li>• No IoT recording</li> </ul>

Vijayalakshmi and Lakshmi (2016)	utilizes wireless innovation Utilizing Raspberry Pi	Real Time Climate Reconnaissance from Far off Area Utilizing Raspberry Pi. To quantify temperature, light intensity, barometrical pressure, Gas/smoke	<ul style="list-style-type: none"> <li>• It cannot be remotely controled also needs the physical personal existance be to take records.</li> <li>• No Gas Receiver</li> <li>• No logging scheme</li> </ul>
Fortes and Borba (2017)	Arduino Climate Data Obtaining Model	Minimal expense Multi Channel Data Obtaining System Plan for heat dampness, barometric pressure	<ul style="list-style-type: none"> <li>• It cannot be remotely controled also needs the physical existance of the personal be to take records.</li> <li>• No Gas Receiver</li> <li>• No logging model</li> </ul>
Al Ahasan et al., (2018)	Arduino and unpredictable natural mixtures VOCs model	Arduino-Based Real Time Air Quality and Pollution VOCs Reconnaissance System.	<ul style="list-style-type: none"> <li>• It cannot be remotely controled also demands the physical personal existance be to take records.</li> <li>• No Climate Model</li> <li>• No logging Scheme</li> </ul>
Vasanthan, and Basha, (2016)	Raspberry Pi Viva Web Execution Climate Estimation Models	Reconnaissance with Raspberry Pi Viva Web Execution . Equipped for observation encompassing parts like intensity, pressure and dampness.	<ul style="list-style-type: none"> <li>• It not be controled and needs the physical human presence being remotely to take records.</li> <li>• No Gas Receiver</li> <li>• No logging model</li> </ul>
Vasudev Yadav, Akhilesh	GSM,	LPG Gas spillage locator	<ul style="list-style-type: none"> <li>• The constraints of such scheme</li> </ul>

Shukla et. al., (2016)			are that it cannot be remotely controlled and needs the physical personal existence to be to take records. <ul style="list-style-type: none"> <li>• Unique Gas sensing unit</li> <li>• No Logger</li> <li>• No climate surveillance scheme</li> <li>• No IoT recording</li> </ul>
Alvear (2018)	swarm detecting models, IoT designs and conventions	swarm detecting structure, IoT models and conventions	<ul style="list-style-type: none"> <li>• It cannot be remotely controlled and demands the physical existence of the personal be to take records.</li> <li>• No Gas Receiver</li> <li>• Single logging scheme</li> </ul>
Devahe ma et al., (2018)	IoT of Arduino, MQ 135 Senor,	IOT Based Air Pollution Reconnaissance Model the Air Quality is figured along a web server, LCD Show	<ul style="list-style-type: none"> <li>• Climate Surveillance Models</li> <li>• Unique Sensing Unit</li> </ul>
Karami, (2018)	Arduino and ZigBee	Real Time reconnaissance of indoor surrounding quality utilizing an Arduino-based and Open source, specialist based software stage for data correspondence.	<ul style="list-style-type: none"> <li>• It cannot be remotely controlled with demands the physical personal existence be to take records.</li> <li>• No Gas Receiver</li> <li>• No logging scheme</li> </ul>
Pan and Zhu, (2018)	Detecting units and Arduino	Air Quality and	<ul style="list-style-type: none"> <li>• It cannot be remotely</li> </ul>

		Residue Monitor with Arduino	controlled with demands the physical personal existence be to take records. <ul style="list-style-type: none"> <li>• No Gas Detector, No logging model</li> </ul>
Pritam Ghosh, Palash Kanti Dhar, (2019)	SMS alert	gas spillage locator	<ul style="list-style-type: none"> <li>• The constraints of such scheme are that it cannot be remotely controlled with demands the physical personal existence be to take records.</li> <li>• Unique Gas sensing unit</li> <li>• No Logger</li> <li>• No Climate Surveillance Models</li> </ul>
Chaudhary, Juhi & Mishra, Anurag, (2019)	Arduino Uno, MQ-6 Gas Identifier, LCD, LPG, Stepper Engine Driver, Bell, GSM mode	Gas Spillage and Automatic Ready Discovery Model utilizing Arduino	<ul style="list-style-type: none"> <li>• Unique Gas sensing unit</li> <li>• No Logger</li> <li>• Climate Measurement Models</li> <li>• No IoT recording</li> </ul>

### 3 Conclusion

An Internet of Things (IoT)-based climate estimation system involves creating a live climate monitoring structure that can track the area's temperature, humidity, atmospheric pressure, and precipitation phase. Here the focus is on different types of climate estimation structures. In this review, the commitments of analysts in this field will be explored by examining the most recent journal articles and focuses in the field of climate control systems. The developments used will be identified and their benefits, harms, determinants, and problems facing their implementation will be studied to reach a long-term vision to know the best developments that can be applied in a weather estimation system based on the Internet of Things (IOT). By reviewing scientific studies and recent articles related to the subject of the study, it was concluded that Arduino-based IoT climate estimation achieves excellent results with the advantages of an IoT-based data logger for climate monitoring using Arduino-based remote identity networks with graphical implementation and remote alarms. With a few drawbacks such as possible internet failure with model failure, no gas receiver, and a poor recording system.

## References

1. H. Chen et al., "The impacts of climate change also human activities on biogeochemical cycles on the Qinghai - Tibetan Plateau," *Global change biology*, vol. 19, no. 10, pp. 2940-2955, 2013.
2. 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)
3. Mircea Popa and Catalin Iapa "Embedded Weather Station with Remote Wireless Control", 19th Telecommunications forum TELFOR 2011 Serbia, Belgrade, November 22-24, 2011, 978-1-4244-4577-1/500- 6/11/\$26.00, IEEE, 2011
4. T.R.V. Anandharajan G. Abhishek Hariharan, K.K. Vignajeth, R. Jijendiran4kushmita "Weather Monitoring Using Artificial Intelligence" 2016 International Conference on Computational Intelligence and Networks. 2375-5822/16 \$31.00, IEEE DOI 10.1109/CINE.2016.26, (2016)
5. Yashaswi Rahul, Rimsha Afreen, Divya Kamini "Smart weather monitoring and real time alert system using IoT" *International Research Journal of Engineering and Technology (IRJET)* Volume: 05 Issue: 10, Oct(2018)
6. Ravi Sharma, Shiva Prakash and Pankaj Kumar, "Methodology, Applications and Challenges of WSNIoT", *IEEE International Conference of Electrical and Electronics Engineering (ICEE—2020)*, jointly organized by Madan Mohan Malaviya University of Technology Gorakhpur and North Dakota State University, Fargo, USA, Pid197, Feb. 14-15, (2020)
7. Garima Verma, Shiva Prakash, "A Comparative Study Based on Different Energy Saving Mechanisms Based on Green Internet of Things (GIoT)", *IEEE 8th International Conference on Reliability, Infocom Technology and Optimization (CRITO-2020)* IEEE Conference Record Number 48877, Amity University, Noida, India, Pid031, June 4-05, (2020).
8. Ferdin Joe John Joseph "IoT Based Weather Monitoring System for Effective Analytics" *"International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8 Issue-4, April (2019)*
9. Raj Kumar, Shiva Prakash, "Performance & Parametric Analysis of IoT's Motes with Different Network Topologies", *International Conference on Electrical and Electronics Engineering*, jointly organized by School of Engineering The University of Malaya, Kuala Lumpur, Malaysia & Centre of Excellence- Power Engineering and Clean Energy Integration, Galgotias University, India in the collaboration with NPTI, Pid 175 January 2nd -3rd, (2021)
10. Garima Verma, Shiva Prakash, "Emerging Security Threats, Countermeasures, Issues and Future Aspects on Internet of Things (IoT): A Systematic Literature Review", *2 nd International Conference on Future Learning Aspects of Mechanical Engineering (FLAME 2020)*, Organized by Department of Mechanical Engineering, Amity School of Engineering & Technology. Amity University, Noida, Uttar Pradesh, India, Pid 231, August 5th -7th(2020)
11. Mary Nsabagwaa, Maximus Byamukamab, Emmanuel Kondelaa, "Towards a robust and affordable Automatic Weather Station ", *journal homepage: www.elsevier.com/locate/deveng.*
12. Ravi Kishore Kodali and Sneathish Mandal "IoT Based Weather Station" 2016 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICT) 978-1-5090- 5240-0/16/\$31.00, IEEE, (2016)
13. 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)
14. 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)
15. Kavya Ladi, 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)* [6] 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)*

16. Tanmay Parashar<sup>1</sup>, Shobhit Gahlot<sup>2</sup>, Akash Godbole<sup>3</sup>, Y.B. Thakare<sup>4</sup> “Weather Monitoring System Using Wi-Fi”, (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2015): 78.96, 2015
17. 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)
18. Ahasan A., Roy, M., Saim, A., Akter, R. & Hossain, M.Z. (2018). Arduino-Based Real Time Air Quality and Pollution Monitoring System.
19. Alvear, O., Calafate, C. T., Cano, J.C. & Manzoni, P. (2018). Crowd Sensing in Smart Cities: Overview Platforms, and Environment Sensing Issues. *Sensors* (Switzerland). MDPI AG February 4, 2018.
20. Asubiojo, O. I. (2016). Pollution Sources In The Nigerian Environment And Their Health Implications. Amegah, & Agyei-Mensah (2016). Urban air pollution in Sub-Saharan Africa: Time for action. *Environmental Pollution*. 220. 10.1016/j.envpol.2016.09.042.
21. Ashenafi Lambebo, Sasan Haghani, (2014). A Wireless Sensor Network for Environmental Monitoring of Greenhouse Gases, ASEE 2014 Zone I Conference, University of Bridgeport, Bridgeport, CT, USA.
22. Bennett J.E, Tamura-Wicks H, Parks RM, Burnett RT, Pope CA III, Bechle M, et al. (2019). Particulate matter air pollution and national and county life expectancy loss in the USA: A spatiotemporal analysis. *PLoS Med* 16(7): <https://doi.org/10.1371/journal.pmed.1003371>. Vol. 317, No. 3
23. Bové, H., Bongaerts, E., Slenders, E. et al. (2019). Ambient black carbon particles reach the fetal side of human placenta. *Nat Commun* 10, 3866 (2019). <https://doi.org/10.1038/s41467-01911654-3>
24. Budioko, Totok, “Sistem Monitoring SuhuJarakJauh Berbasis (2016). Internet of Things MenggunakanProtokol MQTT”, Seminar Riset TeknologiInformasi (SRITI), pp. 353-358, 2016.
25. Chen P. and Jiang X. (2008) Design and Implementation of Remote Monitoring System Based on GSM. *GSJ: Volume 10, Issue 2, February 2022* ISSN 2320-9186 1109 GSJ© 2022 [www.globalscientificjournal.com](http://www.globalscientificjournal.com)
26. Devahema, Garg, Anand, & Gupta, (2018). IoT Based Air Pollution Monitoring System. *Journal of Network Communications and Emerging Technologies (JNCET)* [www.jncet.org](http://www.jncet.org), 8(4).
27. Fortes M.Z. and B.S. Borba, (2017). “Power factor metering system using Arduino”; IEEE. "Design of Low Cost Multi Channel Data Acquisition System for Meteorological Application".
28. FULLWIKIPEDIA (2014) [Online] Available from: <http://www.thefullwiki.org/Microcontroller> Gartner Science and Technology. <https://www.youtube.com/watch?v=TPbKyD2bAR4> Retrieved on 7th Nov.,2019.
29. Gonçalo Mestre , Antonio Ruano , Helder Duarte, Sergio Silv , Hamid Khosravani , Shabnam Peston , Pedro M. Ferreira and Ricardo Horta (2015). An Intelligent Weather Station, Rtrieve from <https://www.coursehero.com/file/36024852/sensors-15-29841pdf/>
30. Guylène Proulx, (2000). Why Building Occupants Ignore Fire Alarms. *Construction Technology Update* No. 42 © National Research Council of Canada.
31. Husain, A.M., Rini, T.H., Haque, M.I. & Alam, M.R., (2016). Air quality monitoring: the use of Arduino and Android. *J. Mod. Sci. Technol*, 4(1).
32. Idowu, A. A. (2000) “Law and Policy in the management of industrial waste in Nigeria” *African Journal of Environmental Studies*. Volume 1, number 1 and 2. Development Africa Consortium Port Harcourt, Nigeria IoT (Internet of Things).<http://gudanglinux.com/glossary/internet-ofthings/>, Accessed October 22, 2019
33. Karami, M., McMorro, G.V. and Wang, L., (2018). Continuous monitoring of indoor environmental quality using an Arduino-based data acquisition system. *Journal of Building Engineering*, 19, pp.412- 419.
34. Karthik Krishnamurthi, Suraj Thapa, (2015). Arduino Based Weather Monitoring System, *Journal of Computer Science*, Volume 3, Issue 2.
35. Komolafe, A.A, Adegboyega, S.A, Anifowose, A.Y.B, Akinluyi, F.O, & Awoniran, D.R (2014). Air pollution and climate change in Lagos, Nigeria: Needs for proactive approaches to risk management and adaptation. *American Journal of Environmental Sciences*, 10 (4), 412-423.

36. Liu, Y., Zhou, Y. & Lu, J. (2020). Exploring the relationship between air pollution and meteorological conditions in China under environmental governance. *Sci Rep* 10, 14518 (2020). <https://doi.org/10.1038/s41598-020-71338-7> GSJ: Volume 10, Issue 2, February 2022 ISSN 23209186 1110 GSJ© 2022 [www.globalscientificjournal.com](http://www.globalscientificjournal.com)
37. Lo Conti, Francesco, Pumo, Dario, Incontrera, Antonia, Francipane, Antonio, Noto, Leonardo Valerio, La Loggia, Goffredo, (2014). A Weather Monitoring System For The Study Of Precipitation Fields, Weather, And Climate In An Urban Area, CUNY Academic Works.
38. Mabrouki, Jamal, Azrou, Mourade, Dhiba, Driss, Farhaoui, Yousef & El Hajjaji, Souad. (2021). IoT-Based Data Logger for Weather Monitoring Using Arduino-Based Wireless Sensor Networks with Remote Graphical Application and Alerts. *Big Data Mining and Analytics*. 4. 25-32. 10.26599/BDMA.2020.9020018.
39. Madhuri P. Patil , S. R. Pachpande, J. P. Chaudhari, & K. P. Rane, (2016) Study of Recent Literature on Weather Monitoring Systems. *International Journal of Computer Applications* (0975 – 8887) Volume 153 – No3, November 2016
40. Mettlach. T., Stennis, Chung-Chu Teng, Weir, R., & LaRue. K, (2008). Quality of archived NDBC data as climate records, *Oceans*.
41. Mittal, D., Vaidya, B. , & J Mathew, (2014). A GSM based low cost weather monitoring system for solar and wind energy generation, *International Journal Digital Information and Web Technologies*.
42. Najwa Nasuha Mahzan (2016). Design and Development of an Arduino Based Data Logger for Photovoltaic Monitoring System. *Journal: International Journal of Simulation: Systems, Science & Technology, IJSSST V17*.
43. Nisha Gahlot, Varsha Gundkal, Sonali Kothimbire, & Archana Thite, (2015). Zigbee based weather monitoring system, *International Journal Of Engineering And Science (IJES)*, Volume 4 Issue 4 .ISSN (p): 2319 – 1805.
44. Olowoporoku, A. O., J. W S Longhurst, and J. H. Barnes. (2012). "Framing Air Pollution as a Major Health Risk in Lagos, Nigeria." *WIT Transactions on Ecology and the Environment* 157(Figure 1): 479–88.
45. O. Ojikel, C. C. Mbajiorgu2, E. Anoliefo3 and W. I. Okonkwo4 (2016). Design and Analysis of A Multipoint Temperature Datalogger. *Nigerian Journal of Technology (NIJOTECH)* Vol. 35, No. 2, April 2016, pp. 458 – 464 . Print ISSN: 0331-8443, Electronic ISSN: 2467-8821
46. Pan, T. and Zhu, Y., (2018). PM2.5 Air Quality Monitor Using Arduino. In *Designing Embedded Systems with Arduino* (pp. 171-187). Springer, Singapore.
47. P. Foundation, Processing.org, 2017. <https://processing.org/>. Accessed October 1, 2019 Puran G., Bhausahab S., and Sagar S. (2014) Review on Gas Leak Detection Techniques. *International Journal of scientific Engineering and Technology Research*. 3(15): 3204-3207.
48. Published Nov 7, 2016. Natanael A. V. Simoes, & Gracinete B. de Souza (2016). "A Low Cost Automated Data Acquisition System for Urban Sites Temperature and Humidity Monitoring Based in Internet of Things"; IEEE 2016.
49. Rasal, M.V. and Jaideep, G. (2016) Raspberry Pi Based Weather Monitoring System. *International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE)*, 5. GSJ: Volume 10, Issue 2, February 2022 ISSN 2320-9186 1111 GSJ© 2022 [www.globalscientificjournal.com](http://www.globalscientificjournal.com)
50. Secerov, Ivan & Dolinaj, Dragan & Pavic, Dragoslav & Milosevic, Dragan & Savic, Stevan & Popov, Srdjan & Zivanov, Zarko. (2019). Environmental Monitoring Systems: Review and Future Development. *Wireless Engineering and Technology*. 10. 1-18. 10.4236/wet.2019.101001
51. Shital M. Dharrao, Vijay D. Choudhary, and Kantilal P. Rane, (2016) Intelligent Bus Stand Monitoring and Control, *Proceedings of the ACM Symposium on Women in Research Soundarya T., Anchitaalagammai J.V, Deepa P., and Karthick Kumar S.S. (2014) C-leakage: Cylinder LPG Gas leakage Detection for home safety. IOSR Journal of Electronics and Communication (IOSRJECE)*. 9(1):53-58
52. Susmithan P. & G. Sowmyabala, (2014). Design and Implementation of Weather Monitoring and Controlling System, *International Journal of Computer Applications* (0975 – 8887) Volume 97– No.3.

53. Thakur, G. A. , A. D. Vishwakarma, & K. P. Rane, (2016). Automatic banana hands bunches measuring & recording Systems. International Journal on Recent and Innovation Trends in Computing and Communication, vol. 4, no. 5, pp. 429-433.
54. Ukemenam, O.S., (2014). Causes and consequences of air pollution in Nigeria. South American Journal of Public Health, 2 (2), 293-307.
55. U.S. Environmental Protection Agency (2021). Retried from <https://www.epa.gov/air-emissionsmonitoring-knowledge-base/basic-information-about-air-emissions-monitoring>
56. Vasantha, J. and Basha, S.M. (2016). Weather Monitoring Using Raspberry Pi Viva Web Application. International Journal of Research (IJR), 03.
57. Vijayalakshimi, K. and Lakshmi, G.V.M. (2016). Real Time Weather Monitoring from Remote Location Using Raspberry Pi. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJARCCE).
58. Xie Z. Tan Q. (2006). A Mini Multi-Gas Detection System Based on Infrared Principle. International Journal Mill waves. Pp. 1639-1649 GSJ: Volume 10, Issue 2, February 2022 ISSN 2320-9186 1112
59. Saijshree Srivastava, Shiva Prakash, “An Analysis of Various IoT Security Techniques: A Review”, IEEE 8th International Conference on Reliability, Infocom Technology and Optimization (ICRITO-2020), IEEE Conference Record Number 48877, Amity University, Noida, India IA, Pid360, June 4-05(2020)
60. Garima Verma and Shiva Prakash, “Internet of Things for Healthcare: Research Challenges and Future Prospects”, Springer, 1st International Conference on Advanced Communication and Computational Technology (ICACCT), NIT Kurukshetra, Kurukshetra, Haryana, India, Pid 75, December 6-7, (2019)
61. Kalsi S.P ( 2008), Satellite Based Weather Forecasting-India, in Wireless Communications and Networking Conference, WCNC-2008.