

# Energy Efficient Cool Roof System to Reduce Carbon Footprint

Ritik Sharma<sup>1</sup>, Gulzar Miglani<sup>1</sup>, Nitin Sharma<sup>1</sup>, Shivam Pundir<sup>1</sup>, Sunil Kumar Chowdhary<sup>1</sup>,  
Abhishek Srivastava<sup>1</sup> and Manoj Kumar<sup>2</sup>

<sup>1</sup>Amity University Uttar Pradesh, Noida, India

<sup>2</sup>School of Computer Science, University of Petroleum and Energy Studies, Dehradun, India

**Keywords:** Energy, Efficient, Cooling, IoT, Building.

**Abstract:** The study aims to evaluate the cooling performance of automatic spraying of water on the roof surface in order to reduce the indoor air temperature in a humid tropical climate. Ceiling spraying can be considered as an evaporation cooling strategy. Firstly, the approach has been tested in a cell test constructed with corrugated sheets for the walls and roof of cement. It is important to note that spraying water can reduce the temperature of the roof area by an average of 5°C. However, lowering the roof temperature cannot be guaranteed to directly reduce the mean indoor air temperature. To achieve a greater advantage of reducing the temperature of the ceiling is necessary to spray water in 20-25 minutes approximately and carried out continuously. Secondly, it has been applied automatic water spraying on the roof. The utilization of sensors, actuators, and controllers are an inseparable part, with the intention of this device will respond vigorously when the roof surface temperature reached a certain threshold, and automatically turns on the pump to spray water. The device has been practiced; it still needs more elaboration for its reliability and investigations on the reuse of water after spraying to allow to reduce energy consumption in buildings.

## 1 INTRODUCTION

Buildings in the humid tropics, face the issue of unnecessary warming as a consequence of the squeezing of hot and moist atmosphere. If not paid attention to these conditions will bring about burden and a misuse of energy for cooling the room. Energy utilization will increment when the structure was planned unconsidered natural conditions, utilization of development materials improperly and disregards the security from direct daylight. Expanding on normal in muggy heat and humidifies face the issue of how to keep up agreeable conditions in the structure. A latent cooling is one of the plans that required for a tropical muggy atmosphere condition. Utilization of climate control system brings about discharge of carbon di oxide gas in the air which is one of purpose behind a dangerous atmospheric deviation. But regular ventilation, there are different strategies, allowing in the detached cooling methodology. The evaporative cooling is one of the detached cooling systems being a still less consideration. Usage of this arrangement will have the option to moderate energy needs of the structure. This plan can conserve the necessary energy

consumption, to put forth an agreeable space condition and attempts to bring down the cooling load definitely. It is fundamental for making a delicate spot that will expand the profitability of the occupiers of the structures. In light of the energy emergency, roof shower cooling strategies have as of late become worthy and desirable. The activity of rooftop splash cooling is a direct and key one; the essential idea means to wet the hot surface and chill it off with splashed water. The chief purposes to protect the warmth out before it fills in and decreases cooling costs in the developments. Maerfat et al. have contemplated the function of the evaporative cooling cavity in living arrangements; they contemplated that the application is effective and get an expansive effect on cooling procedures. Givoni and Joudi and Mehdi inspect the aberrant evaporative cooling with a cooling load changes for lodging, they have reasoned that the uninvolved cooling framework can diminish the room temperature, yet this framework will contrast from each other relying upon the specific atmosphere. Kim et al. have analysed the potential energy reserve funds with immediate or backhanded evaporative cooling by utilizing the open-air breeze and finished

up both these systems could be used for the energy conservation. In 1977, they had additionally tentatively examined in some detail the issue of rooftop lake and rooftop shower at the rooftop surface of a thick strengthened solid rooftop presented to a hot-day bright atmosphere. It was discovered that, by rooftop shower, the pinnacle rooftop temperature diminished from 55 °C to 28°C when contrasted with a decrease from 55 to 32°C on account of rooftop lake. The condition was clearly because of more effective vanishing of water at the roof surface. The rooftop surface temperature was seen to go through a drop of the request for 15°C when contrasted with 13°C on account of the water lake. Kettleborough et al. have led research on how the wet plastic plate as a warmth exchanger was performed for circuitous evaporative cooling. Wongsuwan et al. (2006) have led a test concentrate on the rooftop lake house under tropical climatic conditions; they presumed that the framework could lessen 2-4°C indoor temperature lower than the open air. The handiness of rooftop shower cooling was discovered to be generally helpful in structures with delicately developed, ineffectively protected rooftops. In moderately a similar line with exploration of Zhou et al. that considered the impact of the distinction between a grass rooftop and the rooftop by showering water in a structure with strengthened cement (RC) development.

## 2 PURPOSE OF THE WORK

The establishment of outstandingly astute "cool" coatings for structures revealed that this procedure tends to a shrewd idle response for reducing building energy need and improving metropolitan microclimate by lowering surface and air temperatures. In this light, the current investigation is highlighted, with a focus on the effect of the cool roof application. The working environment region of this surface, which is tended to by such a ceiling adjacent to the housetop, will be depicted with clear and specific thought.

There are three reasons for conducting this preliminary test study. Most importantly, the cool roof will be researched as a response for improving the roof warm lead of such low- execution existing surface, in view of 1969; second, the indoor warm execution of the cooled office space will be assessed through exploratory noticing; and third, the energy use for cooling will be analysed to quantify the cool roof sway the extent that energy saving.

## 2.1 Objective

The aim of paper is to propose a design of evaporative- cooling roof that is applied to buildings in humid tropical climates. The main objective of our Cool Roof System is to reduce the emission of carbon dioxide or other greenhouse gases in the atmosphere by limiting the use of air conditioner. And also, to increase in indoor comfort and reduction in air temperature of room that in turn results in energy saving.

A cool roof translates into:

1. Indoor conditions are more comfort for occupants in the buildings.
2. Reducing power costs in buildings that have air- conditioner system.
3. Increasing the cooling capacity in buildings that have weak in refrigeration system.
4. New buildings, air-conditioning systems design will be smaller capacity (lower cost).

## 3 LITERATURE REVIEW

The ideas of Roof Spray are to cool rooftop in hot atmospheres, subsequently giving cooling to within the structure, have been concentrated by Houghten, F.C., et aln and as of late by Yellot in 1965. Houghten appeared, in tests done at the ASHVE Testing Fhcility in Pittsburgh, Pa., that the technique for an open rooftop lake and a water shower lessens the warmth transition through a wide range of rooftops. Yellot considered the utilization of discontinuous water showers on inadequately protected rooftops. Yellot's work additionally showed the convenience of the water splash in decreasing inconvenience levels in situations where the expenses of ordinary &conditioning could be restrictive. Yellot gave an exceptionally disentangled energy equilibrium to decide the rooftop surface temperatures. Jain and R.Bo., have acquired trial results on the impact of rooftop cooling by vanishing on nonconditioned and adapted structures. Their exploratory set- up was detailed, and the examination took a gander at the impacts of rooftop lake, rooftop splash, and wetted gunny sacks on the temperatures and warmth transition at the roof surface of thick rooftops.

They inferred that, in the jungles, for the impact of diminished indoor temperatures to be more powerful, the rooftops should have been dealt with. They further affirmed the decrease of indoor uneasiness because of the utilization of different

evaporative cooling strategies. The gunny sack had all the earmarks of being the best option followed by the rooftop shower and rooftop lake, in a specific order of adequacy. Tiwari, et al. considered the transient warmth move instrument of the two instances of a rooftop lake and shower cooling. In their diagnostic examination, they decided the water surface temperature as an element of the ecological conditions. They introduced a straightforward warmth mass exchange investigation to decide the evaporative warmth misfortune as an element of weights, speeds, and relative moistness utilizing genuine climate information as a Fourier arrangement for the city of New Delhi, India. They additionally communicated the immersion water fume pressure as a straight capacity of temperature scope of 20°C to 45°C. Their decisions were amazingly steady of the exploratory aftereffects of different examiners. All the more explicitly, they revealed that the decrease in the warmth transition through the rooftop is more noteworthy for lower relative moistness and that breeze speed doesn't assume a significant function in the warmth move component. They likewise presumed that differing rooftop thickness does altogether influence the warmth transition rates.

Chandra, et al. played out an explanatory investigation of the issue and decided the general warm reaction of the structure and within air because of evaporative cooling. They utilized an intermittent warmth move examination like the recognizable Transfer Function strategy to decide the different warmth move systems. They additionally presumed that all the more cooling was accomplished by the technique for rooftop shower as opposed to by the strategy for a rooftop lake. Rao and Kaushika considered the chance of utilizing non-convective rooftop shower lakes with a salt-slope. They closed, nonetheless, that the impacts of convection were valuable, yet that the utilization of these lakes was not suggested. Carrasco, A., et al show planning and introducing a rooftop shower cooling framework on a capacity working in the Research Annex of Texas A&M University. The rooftop splash cooling framework and the related equipment were given and set up on the rooftop by a business merchant. Tests were finished throughout the mid-year of 1986 to think about the splashed and unsprayed conditions on the rooftop surface temperatures, heat move through the rooftop, and the inside temperatures. The outcomes indicated that there was a 60 percent decrease in the warmth move through the rooftop and furthermore a decrease in inside temperatures.

Plan of evaporative-cooling rooftop for diminishing air temperatures in structures in the muggy jungles: This subject focuses to survey the advantages of the evaporative-cooling rooftop, especially for structures with creased zinc rooftops. This investigation underscores utilizations of the evaporative cooling rooftop. Splashing water on the outside of the roof has been executed on the test cell and the reuse of water in the wake of being showered and cooled again by applying a warmth exchanger. Downpour on the Roof-Evaporative Spray Roof Cooling: This paper portrays evaporative splash rooftop cooling frameworks. their parts. execution and applications in different atmospheres and building types. A day-to-day existence cycle energy reserve funds model is examined. Advantages of rooftop life and rooftop top gear productivity and support are covered just as water utilization and execution compromises with substitute techniques for rooftop heat gain control.

Study of Water Layer Effect on Heat Transfer to Building Roof in Summer Season: Objective of this paper is investigation of warm conduct to a structure rooftop which covered by water layer [add water to (0.64 m<sup>2</sup>) from rooftop area] and ascertain season of vanishing. Water layer was added to a model the rooftop and measure the temperature with and without the water to investigation of temperature decrease, impact air speed on the cooling measure, compute season of vanishing and ascertain level of abatement in temperature and warmth move from the roof. The outcomes demonstrated that expansion of water to the rooftop in various conditions lead to temperature decrease (5.57°C to 14.9°C). Examination of a Cool Roof System for Reducing Cooling Loads and Improving Cooling System Efficiency: This paper presents the consequences of a test crusade pointed toward assessing the effect of an imaginative cool rooftop framework on warm conduct and energy execution of a cooled office zone situated inside a modern structure. Assessment of a Direct Evaporative Roof-Spray Cooling System: The model underpredicted the temperatures and the warmth move through the rooftop when the rooftop was dry. The present work included planning and introducing a rooftop splash cooling framework on a capacity working in the Research Annex of Texas A&M University. The rooftop shower cooling framework and the related equipment were given and set up on the rooftop by a business seller. Tests were finished throughout the late spring to think about the splashed and unsprayed conditions on the rooftop surface temperatures, heat move through the rooftop, and the inside temperatures. The outcomes

indicated that there was a 60 percent decrease in the warmth move through the rooftop and furthermore a decrease in inside temperatures.

## 4 METHODOLOGY

This paper deals with a preliminary finished during summer, which approach for data examination contains the going with stages:

- Choice of the logical examination. Given the multipurpose assessment of the examination, a standard Italian present-day configuration is picked to evaluate the effects of cool housetop execution according to substitute perspectives. The imaginative covering is evaluated in like manner as retrofit answer for improve the roof warm execution and augmentation its solidarity, alongside the atomic force examination of the working environment warm zone.
- Indoor-outside noticing. The results uncovered in this paper on a very basic level location exploratory disclosures made through a 2-months long preliminary checking. Both indoor and outside temperature sensors have been presented inside the logical investigation, alongside energy meters for the work environment cooling systems. The test noticing exertion is finished when the usage of a white high smart covering.
- In-field spot assessments campaign. The constant noticing exertion is furthermore consolidated with some intriguing spot assessments. Explicitly the reasonable roof albedo is assessed through a twofold pyranometer presented over the housetop, both when the cool roof application, to assess the effective roof limit addition to reflect overall daylight-based radiation. Moreover, the shallow temperatures of a couple of roof sections are assembled when the covering application: Thus, the covering execution in diminishing the roof overheating and warm dissimilarities is assessed.

Analysis of the roof warm lead. This stage basically contains the examination of the checked housetop temperature, joined with the spot assessments results evaluation. Analysis of the indoor warm direct. The consistent seeing of the indoor temperature of a

central circumstance inside the open office grants to depict the indoor warm profile of this warm zone when the cool housetop execution.

Analysis of the energy saving. Energy usage assessments for cooling have been accumulated. The strategy comprises of utilizing virtual products and durable goods for building up the framework which can be introduced in houses for making the temperature decline in summer climate. The framework is made utilizing mathematical examination as an edge is appointed for the machine to enact consequently, it is a model for the venture, and we can set this arrangement to our homes and may get the outcome as demonstrated by the model. There is a connected application which is made for the entrance of this framework as desired(manual/programmed). The application gives the client to begin or stop the arrangement just as to deal with it as wanted. There is a need of these sort of activities as these days the utilization of energy is expanding

step by step and the impact of utilizing the energy bounteously brings about numerous ecological and topographical changes. The utilization IoT in such situations can make the impact less and can be a vital gamechanger. So, this was the reason and the strategies that we got keen on developing this undertaking.

### 4.1 Existing System

Cool rooftop coatings are white or unique intelligent shades that reflect daylight. Coatings resemble thick paints that can shield the rooftop surface from bright (UV) light and substance harm, and some offer water insurance and therapeutic highlights. Items are accessible for most rooftop types.

Gypsum for cool rooftop, this material accompanies warm protection properties that helps keep your home cool. The air- filled hole between your unique roof and gypsum bogus roof chills the room off. It traps the virus air inside the stay with its protection property.

Tile rooftops can be made of dirt, record, or cement. Tiles can be coated to give waterproofing or covered to give modified tones and surface properties. Some are normally intelligent enough to accomplish cool rooftop principles, and surface medicines can change tiles with low sun-oriented reflectance into cool rooftop tiles.

Metal rooftops are accessible with common metallic completions, stove heated paint completes, or granular covered surfaces. Unpainted metals are ordinarily acceptable sunlight-based reflectors

however helpless warm producers. Painting a metal rooftop can expand its sunlight-based reflectance and warm emittance, permitting it to accomplish cool rooftop status.

Green Roofs are ideal for metropolitan structures with level or shallow pit rooftops and can incorporate anything from essential plant cover to a nursery. Green rooftops likewise give protection, bring down the requirement for warming and cooling, and can lessen the metropolitan warmth island impact.

Single-utilize layers are pre-created sheets moved onto the rooftop and connected with mechanical clasp, followed with synthetic cements, or held set up with balance (rock, stones, or pavers). Reformulate or coat dark films to make them intelligent.

Roof lake as it applies to the zone of energy can be characterized as A sun-based energy assortment gadget comprising of compartments of water situated on a rooftop that retain sun-based energy during the day so the warmth can be utilized around evening time or that cools a structure by vanishing around evening time.

#### 4.1.1 Drawbacks

Some of the Drawbacks of existing solutions are as follows:

Cool rooftops materials accomplish the best cooling reserve funds in hot atmospheres yet can expand energy costs in colder atmospheres because of diminished useful wintertime heat gains. In warm, wet areas, cool rooftop surfaces can be more defenceless to green growth or form development than hot rooftops. In cold atmospheres, rooftops can collect dampness through build-up, and it is conceivable that cool rooftops may be more helpless to gathering dampness.

**High Installation Cost:** The cool rooftops are just ideal for zones that get an exceptionally high measure of daylight. Areas that will in general have long and cold weather months are not reasonable. That is on the grounds that the cool rooftops may wind up chilling off a lot of making your stay entirely awkward in the cooler months.

#### 4.2 Proposed System

We will be making an iot based system which will analyse or compute the temperature of room and roof and then according to the temperature or humidity of room it will activate the sprinkler which would sprinkle water on the roof that would help in

decreasing the temperature of room. Moreover, our system will adjust the voltage of air conditioner.

In this Project we will utilize the DHT11 sensor for assessing temperature and clamminess with the IOT centre point MCU. By this task we will get the qualities to our mobiles and PCs. Along these lines, we can be ready to know the specific estimations of temperature. It is anything but difficult to work and ready to see without any problem. Live temperature or sogginess worth is shipped off a rummage beneficiary through distant sign. The DHT11 sensor identifies moisture and temperature and sends the information to automated stick 5 of Arduino MCU, From Arduino MCU, tenacity and temperature regards are moved to the Cloud at standard time periods through ESP8266 WIFI module. From the Cloud, dampness and temperature esteems can be seen graphically on Firebase comfort stage from anyplace on the planet. With the assistance of WIFI module we can be ready to get to the information.

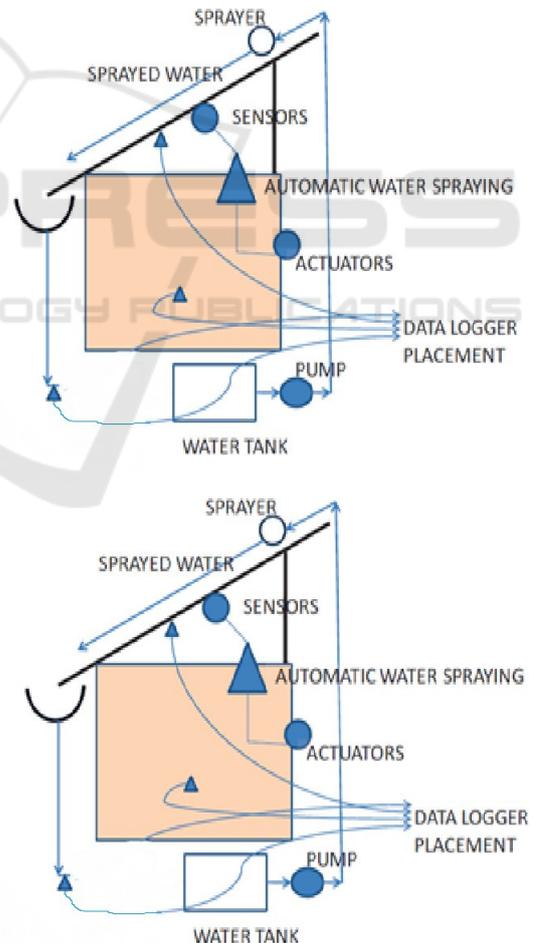


Figure 1 (a): Schematic design of cooling roof device.

A cell test was developed with a 30 cm of length, 12 cm of width and 24 cm of height for the dividers and floor and the rooftop made of concrete sheets. The house test is set outside, in the nursery, as effectively as conceivable presented to coordinate daylight toward the beginning of the day until the evening. A plastic pail loaded up with water as a coolant in which the line covered as high as around 24 cm from the outside of the water. Toward the finish of the copper pipe where the water will be given a plastic hose to the tank. The course water is siphoned out of the tank with a sub siphon. Water is siphoned into the punctured line on one side that will spurt water onto the whole surface of the rooftop. A programmed rooftop showering gadget was planned by parting into different sub-frameworks and afterward will make to be simpler to fix the parts will be polished. Subsystem comprises of a regulator, sensors, and actuators. Each part in the framework requires a voltage source, the microcontroller Arduino UNO, and SSR 25-DA requires a stockpile voltage of 12V to the electrical flow of 3A, while DHT11 and DS18B20 sensor test and a 2x16 LCD need an inventory voltage of 5V.

The DHT11 sensor test is used to evaluate the indoor air temperature. These sensors are truly simple to use with the microcontroller Arduino, and they have a brilliant place of solidness and extremely exact adjustment. The gadget is set up at a specific level of the rooftop surface temperature as a temperature limit boundary on the off chance that it surpasses the level restricted, the regulator will turn on the actuator and a siphon work to splash water on the rooftop. Altogether the equivalent, if the rooftop temperature is not exactly or equivalent to the degree restricted the regulator will kill the actuator.



Figure 1 (b): Proposed Model.

#### 4.2.1 Description of the Model

The model is based on the rooftop cooling system, model is made by of thermocol to show the house in which the hardware is fitted. The roof is made of cement in order to show the heating effect exactly like it will happen on a normal rooftop of a house or building. The heat and temperature sensor is fitted on the bottom side of the roof and when the heat increases on the roof it will sense the temperature, the Arduino MC meter is used to process readings of the temperature on the meter used to show the temperature unit, the Arduino is connected with the meter and with the sensor which senses the temperature and when it reaches a point of temperature on which we need to get the sprinkling of water done the sensor then gives power to the voltage AC/DC compressor which converts the high voltage to low and passes to the pump which is used to sprinkle the water when this whole process happens completely the water then starts to sprinkle on the roof and the roof starts to get cooler and when the temperature decreases the system will automatically get shut off.

#### 4.2.2 Application for Handling

The system made by us for roof cooling is connected and controlled by the application which can be handled manually as well as automatically. We can access this system even when we are not at home so that when we come back the temperature is cooled down because we gave command for the system to start sprinkling the water. And as describes automatically it will work when the temperature reaches its threshold temperature.

#### 4.2.3 Materials and Methods

- **Arduino**

The heart a piece of the structure checking framework; the Arduino is characterized in Wikipedia as " an open-source PC equipment and programming organization, undertaking, and client community that plans and produces single-board microcontrollers and microcontroller units for building computerized gadgets and intelligent items that can detect and control objects in the actual world. Arduino is de-marked to detect the climate as well as encompassing by getting input signal through sensors and speaks with its encompassing through actuators. An actuator could be a straightforward LED (light emanating diode), an engine or sensors, ethernet or some other electronics

relying upon the venture (kushner, 2011). The Arduino equipment are accessible in many configuration and configuration empowering various highlights. The writing computer programs depends on hard-product wiring. The Arduino programming can be sudden spike in demand for Windows, Linux or Mac OS.

The Arduino can be modified to work independent, with PC or other electronic gadgets, which should be possible with Arduino programming which for the most part named as IDE (Integrated Development Environment). Since the Arduino equipment and programming is an open source, there are now numerous clones of Arduino equipment accessible with many energizing highlights. Arduino Uno board is a microcontroller board dependent on Atmel Atmega328 8-bit microchip. There are 14 computerized information and yield pins; 6 of which can be utilized as heartbeat width (PWM) yields. It has 6 Analog information sources and a 16 MHz quartz precious stone or oscillator. Arduino Uno board has USB (widespread sequential transport) link to associate with a PC, a force jack, an ICSP (In Circuit Serial Programming) header and a reset button. Arduino comprises of both an actual programmable circuit board (regularly alluded to as a microcontroller) and a piece of programming, or IDE (Integrated Development Environment) that sudden spikes in demand for your PC, used to compose and transfer PC code to the actual board.



Figure 2: Arduino Uno R3.

• **Sensors**

A sensor is an electronic gadget that changes over a change in actual marvel into an electrical sign. It can send the data to PCs or other electronic gadgets. Thusly, it is a piece of the interface between the climate or actual world and the hardware. The capacity of a sensor is to react to an information actual sign and to change over it into an electrical sign (voltage). It is a semiconductor gadget that is intended to react on change in their resistive or capacitive property relying on the kind of sensor. The presentation of sensor is portrayed by: Transfer function, Sensitivity, Range, Accuracy/Uncertainty,

Hysteresis, Linearity, Noise, Resolution and Bandwidth. The sensors utilized in this work is temperature and humidity sensor-DHT11.

The sensor-DHT11 is an Analog sensor intended to detect the actual change in warmth and dampness when uncovered in air with appropriate wiring and programming. Its little size, modest value, low force utilization, snappy reactions are the characteristics for being probably the most ideal decision for some clients. The sensor DHT11 is material in HVAC (warming, ventilation, and cooling), it tends to be utilized in testing and reviewing gear and customer merchandise. It is likewise material to use in building a climate station or a mugginess controller. The utilization of DHT11 sensor has indicated its value estimating and controlling temperature and mugginess in home machines, clinical and numerous other areas.

The sensor DHT11 has following performance range and accuracy:

**Measurement Range:**

**Temperature**                    **0 to 50 Degree**  
**Humidity**                        **20 to 90% RH**

**Accuracy:**

**Temperature**                    **± 2%**  
**Humidity**                        **± 5%**

Humidity is characterized as the measure of water fume contained in air. As a rule, it is ex-squeezed as supreme moistness, dew point and relative humidity. The sensor utilized in this proposal venture, DHT1, is intended to gauge stickiness regarding relative moistness (RH).

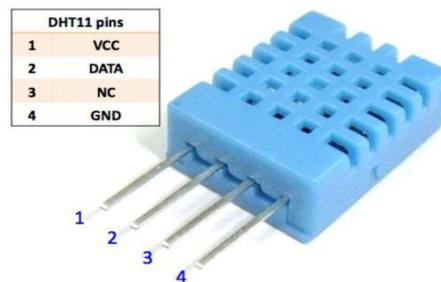


Figure 3: pin diagram of DHT-11 Sensor.

Relative mugginess (RH) is the proportion of the measure of water fume substance of the air to the immersed dampness level at a similar weight or temperature.

• **Mini Water Pump**

It is lightweight, little size, high productivity, low utilization, and low clamour. It has been utilized broadly, in family unit incorporate cooking, cleaning, and so on.



Figure 4: 45-Watt AC Water Pump.

• **NodeMCU ESP8266**

This is utilized to gather all the perusing structure the sensors and ship off web application. NodeMCU. ESP8266 essentially is a wifi module utilized for distant notices. NodeMCU is an open-source Lua based firmware and advancement board uncommonly focused for IoT based Applications. It incorporates firmware that sudden spikes in demand for the ESP8266 Wi-Fi SoC from Espressif Systems, and equipment which depends on the ESP-12 module.

NodeMCU ESP8266 Specifications & Features

- Microcontroller: Tensilica 32-bit RISC CPU
- Operating Voltage: 3.3 V
- Input Voltage: 7-12 V
- Digital I/O Pins (ADC): 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included Onboard
- PCB Antenna
- Small Sized Module to fit smartly inside your IoT Projects

The NodeMCU Development Board can be effortlessly customized with Arduino IDE since it is not difficult to utilize. Programming NodeMCU with the Arduino IDE will barely require 5-10 minutes. All you need is the Arduino IDE, a USB link and the NodeMCU board itself.

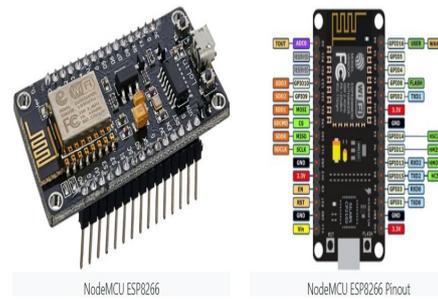


Figure 5: NodeMCU ESP2666.

**4.2.4 Setup/Connection**

Arduino can be modified to give the readings (estimation information) in chronic screen and additionally in the LCD show. The wiring and association is one of the main portion of hardware to work it appropriately. The required materials for the project are listed below:

- an Arduino board (Arduino Uno)
- a breadboard
- a sensor (DHT11)
- a 220 Ω resistor
- a potentiometer
- jumper wires
- an LCD Display

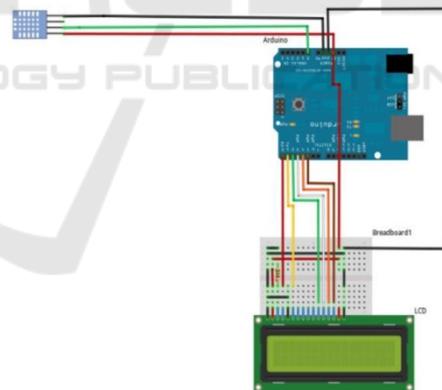


Figure 6: Wiring DHT11 Sensor and LCD display to Arduino UnO.

Wiring DHT11 Sensor and LCD display to Arduino UnO is shown in figure 6. At the point when all the associations and wiring are done, the code ought to be written in IDE and the codes written in IDE advises the Arduino to work with the goal that the estimation acquired from sensor can be perused in LCD.

## 5 WORKING

The Temperature and Humidity Sensor Project will be controlled utilizing an application named (Available for Android and windows) utilizing Arduino, an Ethernet Shield and its libraries. Client can safely login over an application to screen the room temperature and dampness. The code incorporates: The Arduino sketch. The Arduino sketch handles the trades by setting up the framework. The sketch runs the program and passes on each line thusly over the worker. Customers can login distantly on this web worker. Use of DHT11 Sensor: DHT11 capacitive clamminess identifying modernized temperature and sogginess module is one that contains the increase that has been changed cautiously to hail yield of the temperature and tenacity sensors. The sensor consolidates a capacitive sensor, wet parts and a high exactness temperature, assessment devices, and related with an unrivaled 8-piece microcontroller. The thing has extraordinary quality, speedy response, strong adversary of staying limit, and critical cost. It is absolutely trustworthy and has mind boggling tirelessness.

Firestore support is an open-source stage to store and recoup a data for Internet of Things application. To use this, you need to enroll in Firestore cloud and thereafter login to your record. Next, supersede the Hostname and Password with your WIFI name and Wi-Fi mystery key in the two lines given underneath in the program. The Arduino program Uses DHT library, in case it isn't shown in your Arduino IDE, select SketchàInclude libraryàManage librariesàInstall DHT Sensor library. By then gather the program and move to an Arduino Uno through Arduino IDE. Assurance that WiFi modem and web relationship in your Smartphone or PC are working suitably. After moved a program, the Temperature and Humidity data is moved on Console stage. It is worked around Arduino MCU, DHT11 sensor and ESP8266 Wi-Fi module. In this errand, we will develop a little circuit to interface Arduino MCU with DHT11 Temperature and Humidity Sensor. One of the crucial usages of interfacing DHT11 sensor with Arduino is atmosphere watching. A singular wire correspondence can be set up between any microcontroller. like Arduino and the DHT11 Sensor. At that point our proposed framework will examine or process the temperature of room and rooftop and afterward as indicated by the worth that we have set in our code written in Arduino IDE it will actuate the sprinkler A tank loaded up with water as a coolant in which water is being put away. The dissemination water is siphoned out of the tank with a submarine

siphon. Water is siphoned into the punctured PVC pipe on one side that will spurt water onto the whole surface of the rooftop.

A programmed rooftop showering gadget was planned by parting into different sub-frameworks and afterward will make to be simpler to fix the parts will be rehearsed. Subsystem comprises of a regulator, sensors, and actuators. Each part in the framework requires a voltage source, the microcontroller Arduino UNO, and SSR 25-DA requires a flexibly voltage of 12V to the electrical flow of 3A, while DHT11 and DS18B20 sensor test and a 2x16 LCD need a gracefully voltage of 5V. The DHT11 sensor is applied to watch the rooftop surface temperature while the DS18B20 sensor test is used to evaluate the indoor air temperature. These sensors are truly simple to use with the microcontroller Arduino, and they have an amazing purpose of steadiness and exceptionally exact alignment. The gadget is set up at a specific level of the rooftop surface temperature as a temperature limit boundary in the event that it surpasses the level restricted, at that point the regulator will turn on the sprinkler and a siphon work to shower water on the rooftop. Totally the equivalent, if the rooftop temperature is not exactly or equivalent to the degree restricted the regulator will kill the sprinkler. In addition, our framework will change the voltage of forced air conditioner.

## 6 RESULT AND DISCUSSION

### 6.1 Impact of Addition of Water at Various Surface Temperature

It outlines test results to impact of expansion of water on the rooftop temperature at various conditions. The surface temperature before water expansion is (29°C) and (40°C) separately. The outcomes showed that expansion of water prompts a lower temperature because of warmth move to the water for reason for dissipation. It shows that normal of temperature distinction after expansion of water is (4.83°C). While the normal of temperature contrast after expansion of water is (2.9°C). Additionally, show that rooftop surface temperature gets close of encompassing air temperature.

### 6.2 Impact of Expansion of Water at Different Timeframes

To repay water vanished in suitable spans to keep on diminished in rooftop temperature. It delineates

exploratory outcomes to impact of expansion (1L each 60 min.) on surface temperature. The surface temperature previously expansion of water is (38°C). The outcomes show that remunerating water keeps on decrease in temperature, it very well may be through added the water at timeframes determined. The abatement in the pace of temperature is 8.53°C.

### 6.3 Effect of Addition of Water in Dusty Climate

It shows impact of expansion of water with sun-oriented radiation is frail (ex. Dusty climate). The outcomes showed that the expansion of water with feeble sun-oriented radiation decreases more temperature and vanish of water lower. The reduction in pace of temperature is (5.57 C).

### 6.4 Comparison of Proposed Model with Existing Cool Roof Materials

Cool rooftop material or covering can help keep indoor temperature lower by 2 - 8 degrees celcius. While then again, the outcomes showed that expansion of water on the rooftop in various conditions lead to temperature decrease, 5.57-14.9 degrees celcius.

While on the other hand the results showed that addition of water on the roof in different conditions lead to temperature reduction, 5.57-14.9 degrees celcius. Establishment of green rooftop or cool rooftop materials is expensive. While our framework would be more affordable and more achievable.

It has tentatively explored in some detail the impact of rooftop lake and rooftop shower at the roof surface of thick supported solid rooftop presented to a warm day radiant environment. It was seen that, by rooftop splash, the pinnacle rooftop temperature diminished from 55C to 28°C when contrasted with decrease from 55 to 32°C on account of rooftop lake. This was clearly because of more powerful dissipation of water at the rooftop surface. The roof surface temperature was seen to go through a drop of the request for 15°C when contrasted with 13°C on account of water lake. The indoor air temperature endured a drop of the request for 3.5°C when contrasted with that of 3°C on account of rooftop lake. The examination shows that most extreme cooling is accomplished by water splash over the rooftop.

In the initial step, a programmed water splashing gadget is at first applied to the house test. The breaking point rooftop surface temperature is set up at 38°C; it implies the gadget will work when the

rooftop temperature arrives at  $\geq 38^\circ\text{C}$ . The water showering can decrease the rooftop surface temperature fundamentally even from 51°C to 38°C, however it can't radically lessen the indoor air temperature. For now, the water splashing not, at this point ready to bring down the rooftop temperature under 38°C, despite the fact that showering proceeds. This plunge in temperature can decrease the rooftop by showering just at 37.8°C; it isn't not exactly that. This case constrains to change a temperature boundary as an edge esteem. In addition, the temperature boundary is changed at 30°C; it implies the engine will turn on when the rooftop temperature arrives at 38°C or greater and water will be showered.

For correlation of the impacts of water splashing, it is important to isolate into two conditions, specifically with water showering and no splashing. Estimations were cultivated in the time frame from the finish of February to the furthest limit of March in this year. It compares to the initiation of the hot season. For the afternoon, the normal indoor temperature is lower than the external temperature. The rooftop surface has consistently kept up under 38°C and given viably benefits for the daytime. It caused the indoor air temperature is lower than the outside during the day. Truth be told, a programmed showering water onto the rooftop surface can essentially cut the rooftop surface temperature. The automatic water splashing has been applied in the test house. These gadgets can function admirably to run water siphon to shower the outside of the rooftop when it arrives at 38° C or more.

Table 1: Comparison of Energy consumption before and after.

| AC Type | Model   | Star Rating | Power Consumption | Energy Consumption Before (Kw-hr) | Energy Consumption After (Kw-hr) |
|---------|---------|-------------|-------------------|-----------------------------------|----------------------------------|
| Split   | 1 ton   | 5 Star      | 0.58              | 9.8                               | 7.3                              |
| Split   | 1.5 ton | 5 Star      | 1.49              | 14.9                              | 11.2                             |
| Split   | 2 ton   | 5 Star      | 1.73              | 17.3                              | 12.2                             |
| Split   | 1 ton   | 3 Star      | 1.09              | 10.9                              | 8.2                              |
| Split   | 1.5 ton | 3 Star      | 1.56              | 15.6                              | 11.2                             |
| Split   | 2 ton   | 3 Star      | 1.93              | 19.3                              | 14.4                             |
| Window  | 1 ton   | 3 Star      | 1.15              | 11.5                              | 8.6                              |
| Window  | 1.5 ton | 3 Star      | 1.67              | 16.7                              | 12.5                             |
| Window  | 1 ton   | 2 Star      | 1.25              | 12.5                              | 9.4                              |
| Window  | 1.5 ton | 2 Star      | 1.74              | 17.4                              | 13.0                             |

The benefit of applying this technique is to cut down the rooftop surface temperature, which thusly cuts down the temperature of the room. It is essential to say here that the shortcoming of the programmed water showering gadget is to utilize huge measures of water. For the reason of water reuse is a significant business. For the present work it is assumed that the Air conditioner is operated for 10 hours per day. The Power consumed by our proposed model is 0.038 Kw/hr. So, if we run our proposed model for 6 hrs per day, energy consumption would be 0.228Kw-hr. The proposed model results show that evaporative roof cooling or by sprinkling water on roof could help to decrease the indoor temperature of room by 3-7degree celcius in daytime depending upon the weather conditions. Moreover, the results shows that our proposed system could help to reduce the energy consumption (Table 1) by around 25-30 percent depending on the humidity or weather conditions. It tends to be said when thought about with the advantages to bring down the surface temperature of the rooftop then the expense is commendable and solid.

## 7 CONCLUSIONS

The utilization of the rooftop showering as an evaporative cooling procedure has been made. A few estimations have been played out; the showering water on the rooftop surface can lessen its normal temperature by 5°C. In any case, the rooftop surface temperature didn't naturally decrease and straightforwardly below normal room temperature. With respect to lowering the rooftop surface temperature, the water splashing has adequately to be rehearsed each 10-15 minutes and constantly rehearsed, particularly when the outside temperature is exceptionally high. The programmed water splashing has been carried out in the cell test. This gadget can work effective, particularly running water siphons to splash the rooftop surface when arrives at 38°C or more. The benefit of utilizing the strategy is to diminish the rooftop surface temperature contrasted with the indoor temperature. It is critical to say here that the shortcomings of this programmed water splashing gadget are to utilize water in critical amounts. The work was effective in building a checking gadget which functions as a thermometer for estimating temperature and mugginess inside a structure; it is equipped for estimating dampness and temperature outdoors. The Arduino-based observing framework effectively diminishes the Arduino based observing gadgets are the additional opportunities for creating keen

gadgets unreservedly with little spending plan and basic work. The quickening race of trend setting innovation outdates the innovation utilized in Arduino Uno in a matter of seconds; progressed programming working comparatively are accessible. The Arduino is modified to utilize a USB link to interface with PC while there are numerous different sheets accessible with various highlights. After effectively composing, the codes on IDE and subsequent to finishing the confirmation the program is transferred in Arduino. While the program is running, the PC shows the perusing successfully project was intriguing and was essentially useful to figure out how to utilize microcontrollers (Arduino), programming language C and fundamental gadgets.

This was a useful favourable project in learning and understanding the universe of microcontrollers, and utilizing microcontrollers, all things considered. The further work is to apply the programmed water splashing on the top of test house. the outcomes showed that expansion of water on the rooftop in various conditions lead to temperature decrease, 5.57-14.9 degrees celcius. While on the other hand the results showed that addition of water on the roof in different conditions lead to temperature reduction, 5.57-14.9 degrees celcius. The examination shows that most extreme cooling is accomplished by water splash over the rooftop. These gadgets will function admirably to run water siphon to splash the outside of the rooftop when it arrives at 38° C or more. The upside of applying this technique is to cut down the rooftop surface temperature, which thusly cuts down the temperature of the room.

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