IoT-Based Smart City

Project report submitted in partial fulfillment of the requirement for the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

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DECLARATION

We hereby declare that the work reported in the B.Tech Project Report entitled **"IoT-Based Smart City"** submitted at **Jaypee University of Information Technology, Waknaghat, India** is an authentic record of our work carried out under the supervision of **Dr. Vikas Baghel.** We have not submitted this work elsewhere for any other degree or diploma.

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Dr. Vikas Baghel
Date: 20/05/2021

Head of the Department

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Thank you

LIST OF ACRONYMS AND ABBREVIATIONS

IoT	Internet of things
ICT	Information and Communication Technologies
IDE	Integrated Development Environment
USB	Universal Serial Bus
LED	Light Emitting Diode
TX	Transmitting
RX	Receiving
I/O	Input/Output

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ABSTRACT

Massive Internet of Things (IoT) deployment allows Smart City projects and initiatives all over the globe. The IoT may be a modular approach for fusing different sensors with all ICT solutions. By 2022 more than 49 billion items will be connected and installed in smart cities. IoT connections are at the core of smart cities activities. IoT is expected to embrace the idea of Smart Cities, which seeks to use the most modern networking technology to plug infrastructure for city management and thus residents. This report provides a detailed analysis of the principles and goals of IoT and smart cities and their implementations. In fact, this report describes the use of DHT11 humidity and temperature sensor and smart parking system in setup of IoT based Smart City.

In this report we have briefed about use of temperature and humidity sensor and smart parking system using Arduino for setting up smart city. It is based on Arduino Uno temperature and humidity sensing DHT11 sensor for measurement, Sonar sensor and Buzzer. We have discussed about various aspects of IoT Such as working, key components and its security.

CHAPTER 1- INTRODUCTION

1.1 IoT(Internet of Things)

IoT — The Internet of Things (IoT) is a network of 'smart' devices that link and interact via the Internet. The secret to IoT is the interconnectivity between devices that capture and share information via embedded apps, cameras and sensors that detect items like light, sound, distance and movement, new generation movables system, buildings, and also daily use electrical devices that we tend to use on a standardized basis inter-connected to every different over the web as a result, they will gather and share information in between. Such "Things" have precedence and therefore the power to organise themselves and to interact with other objects without human requirement/interference [1]. There is area unit over six devices per user linked to the Web [2]. The IoT concept intends to give the web even more omnipresent and even more immersed. Furthermore, by providing easy access to and connectivity with a wide range of devices such like domestic appliances, tracking, cctv cameras, alarms, screens, sensors, and automobiles.

For home automation, tracking, surveillance devices, alarms, screens, actuators and cars. IoT may enhance the incidence of numerous applications based on the vast quantity and form of information created by artifacts to deliver additional services to enterprises, residents and public authorities. The unit area of IoT applications varied and fell in many areas and fields, for an instance: Home monitoring, personal hospitals, robotics engineering, elderly assistance, patient support, transportation, smart grids and integrated energy control , traffic regulations, etc.[3]. The framework of the IoT is subject to smart and self-configuring objects which are incorporated into a universal network basis. This will bring new information and networking technology resources sector, covering the thanks to various technologies and software able to exploit the physical and virtual world interconnections. IoT is also defined as' Objects with virtual identities and identifiers in smart areas that use smart interfaces to interact and communicate within the framework of medical, social, environmental and users[4]. The IoT's effect on users' longevity is also seen as its main feature. This dilemma has led to the expansion of several, sometimes conflicting projects for the potential identification of IoT systems.

Accordingly, the notification of an IoT network from a system perspective, commonly with the specified backend network services and devices, still requires established best practices due to its sophistication and innovation. Furthermore, in comparison to technological difficulties, the IoT concept is jointly based on lack of a specific and explicitly agreed business plan that can draw expenses to broaden the application of such technologies[5]. The smart places region unites those who build the use of such good things to perform different functions such as lighting, traffic management, connecting different cities, regulation of the energy use and emissions. Healthy cities' main intent would substitute the way of how we look at things. About the many aspects in which IoT is going to prevail we can say that IoT will affect everything from some of the most dependable day-to-day actions to the most complex feelings and emotions. Commonly, people would benefit mainly from the successful town applications and hence the overall climate, as shown in Figure 1.

The mostly good town applications based on IoT are also a private assistant to a citizen's everyday routine. For egg, to remind him of his next appointment to maximize his temperature by outside weather in order to build his occasional on time. It can identify his health whether he suffers from any issue and notify or alerts its particular doctor only in the emergency situation. For smart cities there is a formal definition[6]. Devices are often embedded in the IoT features which support the physical region and are assessed using an analysis system. Sensor systems may be used to capture person data in various programs such as bicycle tracking, cars, and outdoor parking spaces.

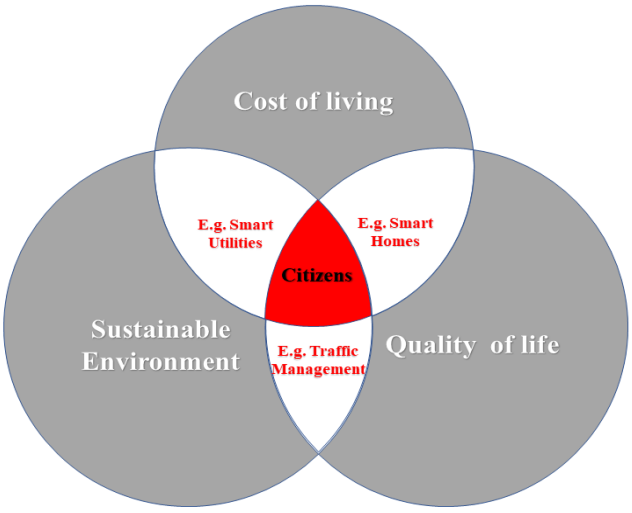

Figure 1. Fundamental objects of smart cities

The one of important function of a smart home is to assist disabled persons and elderly people. These home systems use technological devices to cater the specific disabilities of an operator. Speech recognition control can help users with visual and movement limitations whereas alert systems can be directly tied to hearing aids worn by users with hearing impairments.

The Internet of Things will encrypt between 50 and 98 trillion objects, and be able to track such objects' motions. Individuals are now surrounded by 1000 to 5000 trackable items in surveyed urban areas. In 2016 there were already 85 million mobile devices in people's living places. This figure is projected to exceed to 200 million devices by 2022.

1.2 IoT and The Cloud Platform

As you know now that IoT is basically, a network of interconnected smart devices that are connected amongst each other to share and process data and made it to a useful information to the platforms users. The interconnectivity between the all the devices in IoT platform is achieved through the Internet of things cloud services. Significantly larger use of the IoT in cloud has served as a tool for designing and implementing functional applications and business models on the Internet of Things. Cloud computing and IoT have become two very closely related coming futures internet technology with one offering a forum for progress with the other. The integration of IoT and Cloud computing has generated various benefits.

IoT with cloud gives cloud computing services, by offering third - parties access to the network, will effectively support the IoT region. The integration will thus assist IoT data or computing elements that runs over IoT computers.

Improved efficiency: IoT systems need a great deal of capacity to exchange information for useful purposes. IoT in the cloud, like StoneFly Cloud Connect to Microsoft Azure, will offer more space for customers and can increase depending on user requirements. Helps address consumer data demands.

Work efficiency: The vast volumes of data generated by IoT devices demand intense effectiveness to communicate with each other and to link. IoT in cloud offers the communication required to exchange information between devices and make sense of it at a rapid rate.

Pay-as-you-go: Internet cloud computing providers allow IoT to make the greater quantity of data developed significant. Users don't care about having more capacity or fewer. With Internet Cloud Computing, they can conveniently scale storage as the data generated rises and compensate for the amount of storage they use.

Mostly with growing proliferation of multi-domain and hybrid computing systems, institutions are waking to cloud technologies becoming indispensable. There is also a marked change in the IoT world. Every second day new technologies and sensors are being dealt with, allowing more advanced cloud computing applications to be implemented. Security concerns, which since its inception have been a big concern of the IoT community, may be a difficult one here. This is all about accountability in the cloud network versus on-premise collision with IoT technology.

It is in the hands of the client in the case of on-site servers and it relies only on the security policies within the enterprise that the records are kept secure. Thus it is indeed very acceptable that some organizations may feel insecure abandoning control of their sensitive information and carrying it on to an outside party. Although there is general consensus from both service providers and consumers that it is easier to store and process the Internet of Things data in the cloud than to retain it on premises.

As cloud computing is all the way to go these days, it is slowly becoming an integral feature of almost every business enterprise, whatever the size. It is safe to presume, in the midst of these breakthroughs, that cloud computing will continue to offer opportunities for the growth of the internet of Things. Cloud networking, stability, and computational power can start an IoT space revolution.

1.3 IOT APPLICATIONS FOR SMART CITIES

The business of various application IoT is growing so exponentially that capturing the scope of technologies in this field is an offering a huge. Yes, a variety of services, including the lighting, public transport, waste water systems, emergency care, traffic control and more may be known as "smart cities."Modern IoT smart city projects/initiatives are very likely to appear as available

Solutions become more predominantly implemented and very much oriented on unique usage cases criteria. We'll include urban lighting, public transit, waste treatment, and water management. The network is used by the IoT and other wired data infrastructure to combine various devices. In order to promote connectivity together, all computers on the market will be connected to the cloud. Sensors, cloud, gateway and Arduino Uno are necessary to fulfill this function.

1.3.1 Smart Parking

Smart cities require smart parking and local residents ought to park their vehicle anywhere without needing to travel an unnecessary path to their location. The potential of smart parking solutions will allow everyone to make use of all the available spaces while greatly enhancing parking management performance for both vehicles and authorities managing this critical urban tool.

Parking a vehicle in overcrowded parking facilities and little narrow places is a difficult task and the main thing is that you have to be strictly vigilant when reversing so that you don't hurt the vehicle (ones vehicle and the neighboring ones) smart parking system is answer to it. Smart parking permits the town to earn the next profit by utilizing identical parking zone oftentimes. The areas will be utilised up to their fullest capability. It additionally boosts the quantity of greenbacks.

1.3.2Smart Waste Management

Every humans produce urban solid waste on a regular basis, generally known as waste material, but basic waste disposal systems in cities are often taken for granted by people before a garbage bin outfalls. As a result of recent demographic development and urbanization, waste generation has expanded in cities and municipal waste disposal activities have to be modified to ensure clean and unpolluted cities. Thus reducing the chances of spread of many diseases.

Disposal of waste is an essential city facility but current waste management mechanisms are

Resource-intensive, ineffective and inaccurate. The Internet of Things (IoT) does have the ability to profoundly optimize gathering efficiency and reduce city operational expenses.

Implementation of smart waste management resolution allows cities to scale back operational cost accounting by putting in sensors within the bins. It facilitates in observance the amount of trash in every bin. Bins may be empty or can be full. So, there's no have to be compelled to follow any standardize method to gather the waste from bins overtimes'. Once the bins area unit full, the various department can get alerts through the sensors. Waste collection truck will empty the bin. This project reduces the amount of waste collection vehicles on the road on the average. It clearly reduces the traffic and fuel price. And also adds to beauty of the city.

1.3.3Smart Lighting

Smart lighting is an energy-efficient illumination system. This may involve high-efficiency fixtures and automatic systems that allow changes depending on factors such as the amount of occupancy or daylight. Lighting is the purposeful deployment of light to produce a certain artistic or functional effect. It requires lighting for the activities, lighting for the effect and general lighting.

Decreased usage of power and energy solves victimization the smart lighting. Intelligent lighting management will contain dimming lights on streets while not traffic and pedestrians. Many times, good lighting systems are provided with a central management package that tracks usage and ends up in maintenance potency.

1.3.4 Smart homes, Offices, and Buildings

The smart home is a home which utilizes internet-connected technologies to facilitate remote monitoring and control of equipment and services, such as air conditioning. At the simple level, smart building provides important building facilities that make the occupant efficient (e.g., lighting, thermal comfort, air quality, physical protection, sanitation, and so on) at the lowest cost and effect on the building life cycle environment. To accomplish this dream includes the application of knowledge from the outset of the planning process right to the end of the usable life of the house. Having homes and buildings with specialized IoT devices could help in decrease wastages and various other aspects as-

In resource utilization associate with buildings (electricity and water) similarly as in increasing the level of accomplishment of humans inhabiting them. Via the information they produce, sensors will keep sensitive homes under surveillance and management[5].Price is the substantially distinct benefit in sensible homes, as additionally wired apps can exploit further infrastructure and release the individual into different obligations.

1.4Objectives

- The project objective is to use live temperature and humidity sensor, sonar sensor and various other sensors for making a smart city using Arduino Uno for smart cities.

- Cost minimization and reducing human force and work power for city management.

1.5 Scope of the project

- IoT-Based Smart city uses temperature and humidity calculation system which provides an efficient and safe system for detecting home and agricultural parameters.

- Smart parking system helps in saving fuel which results in less C02,S02 and other harmful gases emission

- It can further be used in field of home and workplace automation.

- Project can effectively decrease cost of installing various system and human work hours.

CHAPTER 2- ARDUINO UNO&DHT11 SENSOR

2.1Temperature and Humidity Sensor

DHT11 Temperature and Humidity Sensor have a complex sensor of temperature and humidity with a calibrated digital signal output. It ensures high reliability and excellent long-term stability by using the proprietary digital-signal-acquisition technique and temperature & humidity sensing technology. This sensor includes a resistive measuring part for humidity and a temperature measurement. And connects to an 8-bit high-performance microcontroller, delivering excellent quality, fast response, anti-interference capability and cost-effectiveness. The compact scale, low power consumption and transmitting of up to 20 meters of signal make it the perfect option for different applications including the most demanding ones. The part is a single row pin kit with 3 pins.

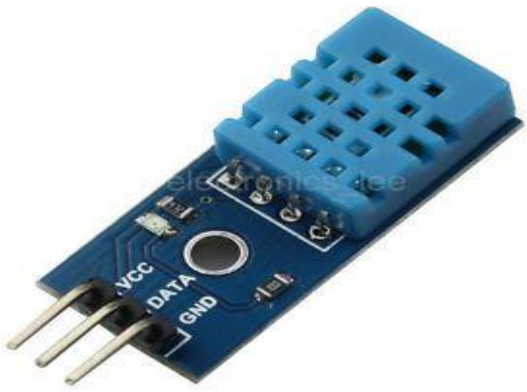

Figure 2. DHT11 Sensor

Table 2.1: Specifications of DHT11

Sr. No 1	Size	22.0 X 20.5X 1.6(In Millimetres)
2	Working voltage	3.3/5V Direct Current
3	Operating voltage	3.3/5V Direct Current
4	Measurement ranges	20-95 % Rh ; 0-50 °Celcius
5	Accuracy	05% , ±1 °Celcius

Applications:

1. Temperature and humidity levels Measurements.
2. Local weather forecast.
3. Could be employed on Automatic air conditioning systems.
4. Monitoring of the climate changes and patterns.

2.2Arduino Uno

Arduino is an open-source development framework, based on easy-to-use applications and hardware. It consists of a programmable circuit board (called a microcontroller) and a ready-made device called Arduino IDE (Integrated Development Environment), used to write and transfer the programming code to the actual machine.

The silent features are:

- Arduino boards are capable of reading analog or digital input signals from various sensors and converting them into outputs such as triggering a generator, converting on / off LEDs, connecting to the cloud and other acts.
- You could perhaps control the functions of your board by sending a set of instructions to the board microcontroller via Arduino IDE (software upload).
- In comparison to other previous programmable circuit boards, Arduino does not require an additional piece of hardware (called a programmer) to add a new code to the board. You can use a USB cable, easily.
- The Arduino IDE also provides an easy C++ version to make it easier to learn programming.

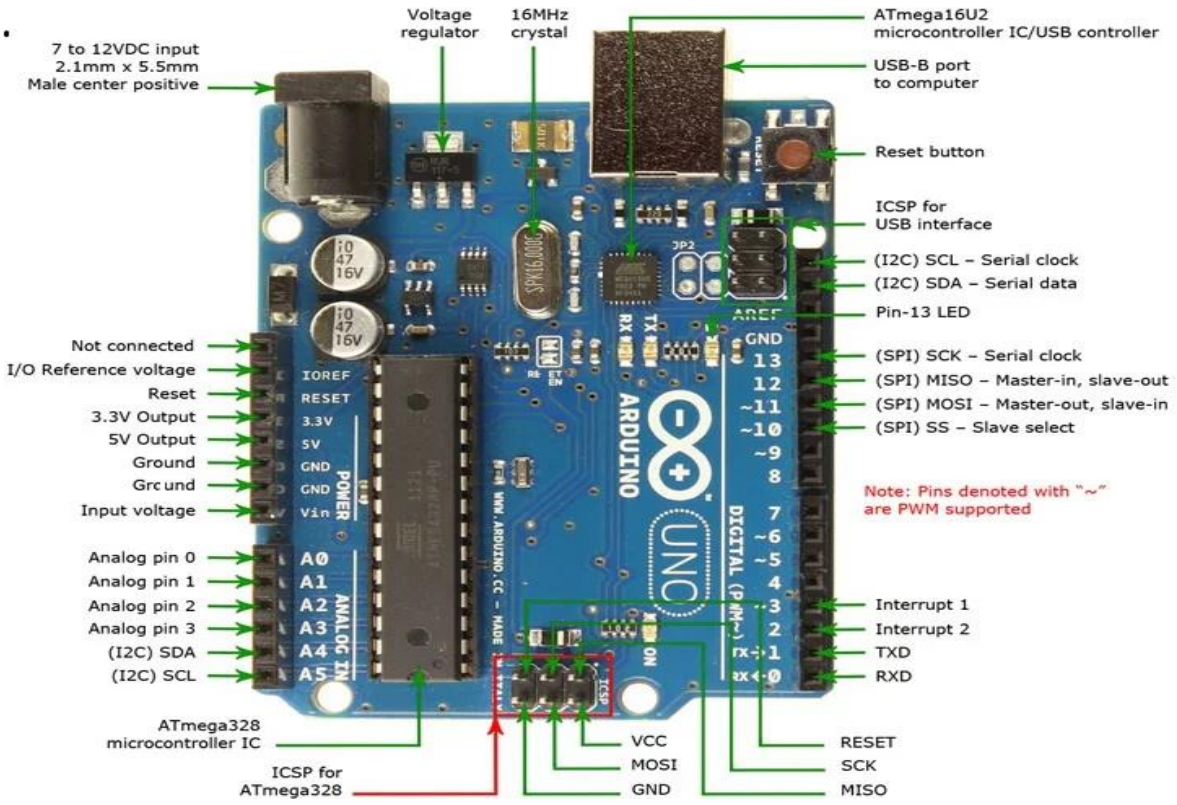

Figure 3.Arduino UNO

2.2.1 **Arduino Board Description**

➢ **Power USB Supply**

Arduino board can all be operated from your device using a USB cable. You just have to connect the USB cable to the USB port of your devices.

➢ **Arduino Reset**

Arduino board is able to reset, that is start program from the start. The board of the UNO shall be reset by two ways. First, using the onboard reset button. Second, attach the external reset button to a RESET labeled Arduino pin.

➢ **Pins (3.3, 5, GND, Vin)**

- 3.3V : Supply 3.3 output volts
- 5V : Supply 5 output volts

- Most Arduino board components work perfectly with 3.3 volts and 5 volts.
- GND (Ground pin): A Arduino has many GND connectors, one of which can be used for grounding the circuits.

•Vin: This pin could also be used as an additional power source to control the Arduino board, such as the AC power supply.

- **Analogue pins**

The Arduino UNO board includes five analogue A0 through A5 input pins. Such pins could interpret the signal from an analog sensor, such as the humidity sensor or temperature sensor, and translate it to a digital representation that the microprocessor can read again.

- **Main microcontroller**

Every Arduino board has its own microcontroller. It is our Board's brain. The Arduino 's main IC (integrated circuit) is subtly different from board to board. Typically the microcontrollers are from ATMEL Corporation.

- **Power LED indicator**

As microcontroller plugs into a power supply this LED will light up to show that the board is properly powered up. When the light doesn't turn on, then the connection is incorrect.

- **TX and RX LEDs**

There are two marks on board: TX (transmit), and RX (receive). They turn up on the Arduino UNO board in two positions. First, the pins responsible for serial communication should be indicated at the digital pins 0 and 1. Second, followed by the TX and RX. The TX led flashes at different speeds while the serial data was being sent. RX flashes during cycle of receiving.

- **Digital I / O**

The Arduino UNO board will have 14 digital I / O pins (of which 6 give output for PWM (Pulse Width Modulation). The above pins could be configured to operate as digital input pins for reading logic values (0 or 1), or as digital output pins for driving various module such as LED's.

- **AREF**

AREF stands for Analogue Reference. It is often used as the upper limit for the analog input pins to set an arbitrary reference voltage (between 0 and 5 Volts).

Table 2.2: Specification of Arduino UNO

Sr. No.		
1	Microcontroller	ATmega328P
2	Operating Voltage	5V
3	Recommended Input Voltage	7-12V
4	Input Voltage Limits	6-20V
5	Analogue Input Pins	6 (A0 – A5)
6	Digital I/O Pins	14 (6 provides PWM output)
7	DC Current on I/O Pins	40 mA
8	DC Current on 3.3V Pin	50 mA
9	Flash Memory	32 KB (0.5 KB is used for Boot loader)
10	SRAM	2 KB
11	EEPROM	1 KB
12	Frequency (Clock Speed)	16 MHz
13	Length	65.6 millimeters
14	Breath	54.4 millimeters
15	Total Weight	24 g

2.2.1 How IoT Works?

The whole IoT process begins with devices such as mobiles, fitness bands, electrical gadgets such as Televisions, microwave that helps users communicate with the IoT system. There are four components of IoT working-

- **Sensors/Devices**

Firstly, the sensor and the devices collect data from the surroundings. This could be anything like temperature, humidity, or real time video feedback.

- **Connectivity**

Now, that data is uploaded to the cloud platform. This is done by various of methods such as: mobile data, satellites, Wi-Fi, Bluetooths, or connected to the internet via the Ethernet cables.

- **Data Processing**

Once the data is uploaded to the cloud, software performs data processing on it. It can be a temperature range check that device is in permissible limits as set by the user. Or it can be used to detect the motions Using AI algorithms as hill climbing in case of there is an intruder.

- **User Interface-**

Finally, information gathered can be made useful to the user with a warning to the user (email, fax, message, etc.). Example-A text message if the temperature in the company's cold storage is too high. User has a GUI where he / she can get these warnings and take necessary action. The user may set the temperatures in the cold storages remotely via an app in their smartphone. IoT system can automatically adjust the temperature, rather waiting for you. The system could do the same automatically by means of predefined rules. In addition, the IoT device may instantly alert local agencies like police in the event of an intruder.

2.3 IoT security

IoT security is the division of technology dealing with the safety of interconnected computers and networks throughout the internet of things (IoT).Following a set of large events in which a simple IoT system was used to penetrate and attack a wider network, IoT security has come under attention. To ensure the protection of networks with IoT devices attached to them, security steps must be implemented.

2.3.1 Security vulnerabilities with IoT

A variety of barriers prohibit IoT devices from being secured and end-to-end protection in an IoT system. Since systems administration machines and different articles is moderately new, security has not generally been viewed as main concern during an item's plan stage. Moreover, on the grounds that IoT is a beginning business sector, numerous item originators and makers are more keen on getting their items to advertise rapidly, instead of finding a way the important ways to assemble security in from the beginning.

There are no industry-accepted guidelines for IoT protection. Although there are several IoT security mechanisms available, no single architecture has been settled upon. Large business organisations may develop their own standards, while some sections, such as industrial IoT, have proprietary, incompatible standards developed by business leaders. Because of the complexity of such standards, it is challenging to not only stable frameworks but also to standardized. The integration of IT and operating infrastructure networks has posed a variety of difficulties for system administrators, including those charged with safeguarding applications and maintaining end-to-end safety in areas beyond the their competence. There is a learning experience, and IoT protection can be handled by IT teams with the appropriate technical skills. Associations should seek out how to see security as a common issue, from producer to specialist co-op to end client. Owners and professional organisation should prioritize the security and safety of their product, as well as include encryption and approval as a matter of course, for an instance. However, the onus doesn't end there; end clients should make certain to avoid potential risks, including evolving passwords, introducing patches when accessible and utilising security programming. Since the mid 2000s, when the IoT idea was first proposed, security analysts have made a point of vast quantities of improperly secured

Computers connecting to the internet. Following that, a range of threats have hit news, ranging from attackers infiltrating baby monitors and talking to children to smart freezers and televisions being used to deliver spam. These types of attacks are very alarming. It's worth noting that certain IoT hackers don't go after the machines specifically, while also using them as a gateway into a wider network.

- With increase in use of IoT based devices, there is also increase in cyber attacks on devices.
- According to studies, it is found that there is 300% increase cyber attacks in 2019 compare to 2018.

- This compromises user privacy and could be very dangerous

How to prevent attacks on IoT networks

- Check Your IoT Device Settings and Keep Them Updated-
    - Most of the devices comes with default settings that are set by manufacturer and they are same for all the devices, so always change these settings such as passwords[5].

- Keep your device updated, as it fixes previous bugs and threats.
- Enable Two-Factor Authentication-

    - This feature provides an extra layer to devices security in addition to passwords, these are unlock patterns, facial recognition or finger print sensors used to grant access to the user and save it from potential attackers [6].

CHAPTER -3: CIRCUIT IMPLEMENTATION AND RESULTS

3.1 Circuit Diagram

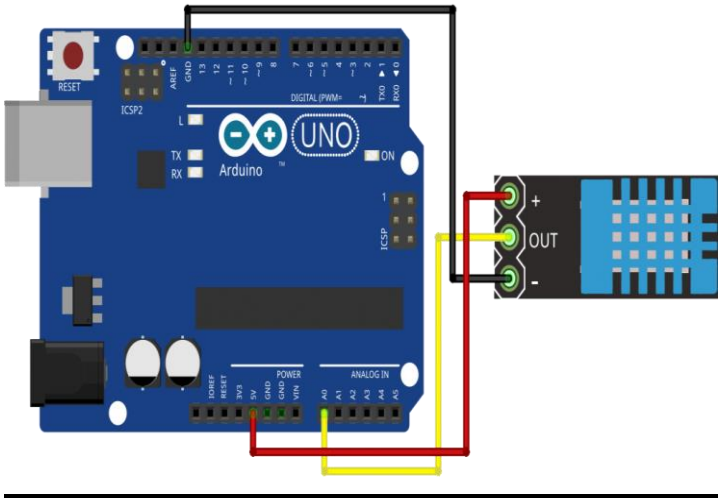

Figure 4.Arduino Uno with DHT11 Sensor

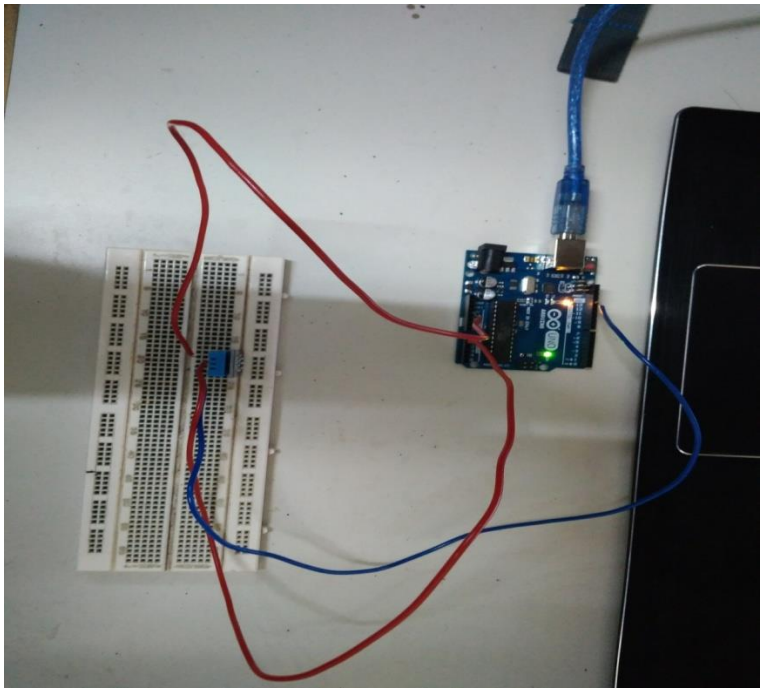

Figure 5.Arduino Uno with DHT11 Sensor Physical Implementation

3.1.1Results

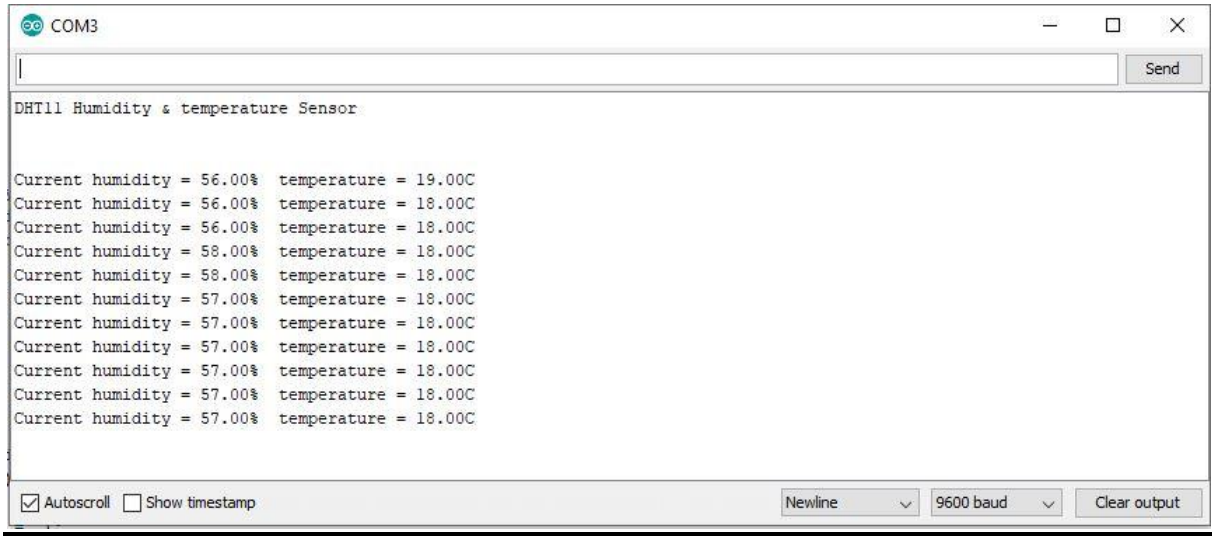

Figure 6. Real Time Readings(Temperature and Humidity)

CHAPTER - 4

Smart Parking System

4.1 PARKING PROBLEM

Drivers trying to search for parking are reported to be responsible for approximately 30 per cent of urban traffic jams. Traditionally, metropolitan areas, business owners, and developers of properties have tried to match the parking supply with the increasing demand for parking spaces. However, it has become apparent that merely adding additional parking spaces isn't enough to solve the congestion issue. Innovative methods using smart parking systems aim to have a much more balanced view of the car park that better maintains the supply-demand relationship.

With the rise in internet customers in our country, everybody has a Smartphone and internet connection so they want to be able to do all their work, whether they are buying stuff or try to book cinema tickets at one place. Or booking a parking space for their vehicles. Smart Parking is a quick fix to all of these difficulties that we can minimize human commitment as well as provides parking stations that work more securely and quickly. Now citizens don't have to waste their fuel, time and money on finding the parking areas. It’s a tedious task to park a car in very narrow parking lots and relatively small areas and the crucial part is that you have to be very attentive when reversing so you don't damage the car (your car or adjacent).Nearly all new cars are fitted with reverse parking sensors which are triggered whenever the car is put in reverse gear and beep at variable speed based on the distance between both the car and the nearest obstacles. This will also solve the big problems, i.e. caused primarily by the unlawful parking of commercial vehicles on roadside.

The concept of smart parking is the ability to access, collect, analyze, propagate and act upon parking usage information. Progressively, this information is given in live time from smart devices that allow parking supervisors as well as drivers to maximize parking capacity utilization. Parking quest burns about one million barrels of oil a day. An ideal parking strategy would dramatically reduce travel time, thus decreasing the volume of everyday vehicle pollution and consequently minimizing global pollution footprint.

Parking lot staff and security guards provide real-time lot data and will help to capture appropriate video. Lower spot-search traffic on the streets can also help decrease parking breaches and suspicious actions. License plate recognition can

Dramatically reduce accidents resulting from the distraction of parking search. A smart parking solution can generate data over time that discloses correlation coefficients and patterns between users and lots. These patterns can prove crucial to many owners as to how drivers can be adjusted and improved.

4.1.1 Smart Car Reverse Parking System

Annually, approximately 500 people get killed and 2500 people are wounded by cars backing up in driveways or parking lots. Where available parking spaces are limited or inadequate, reverse parking is used. The car comes to a halt ahead of the available parking space, and then reverses direction and parks in the available spot. Reverse parking is perhaps more comfortable and it allows you to park a vehicle of the smallest possible measurements.
Sensors, communication protocols, and software solutions are the core components of smart parking systems technology. The most critical aspect is the sensor, which gathers data and feeds the system overall. A gateway controls networking protocols and links sensors to computing devices by introducing wireless IoT protocols. Ultimately, software service ensures the knowledge is accessible to everyone via a service.
Parking a vehicle in overcrowded parking areas and narrow spaces is a difficult task and the main thing is that you have to be very watchful when reversing so that you don't hurt the vehicle (ones vehicle or the neighboring one). Nearly all new vehicles are fitted with reverse parking sensors that are triggered when the car is positioned in reverse gear and beeping at varying frequency based on the gap between the object.

Ultrasonic proximity sensors, i.e. they avail ultrasonic sensors to measure the distance between the vehicle and the target to alert the drivers if the vehicle is too near, are the reverse parking sensors that are fitted on the car. This system can be applied in many advanced, automated driving programs.

4.2 Ultrasonic Sensor (HC-SR04)

An ultrasonic sensor is the device that makes use of ultrasonic sound waves to determine the distance to an object. An ultrasonic sensor utilises a transducer to transmit and receive ultrasonic signals that convey back information about the location of an object. The HC-SR04 is great, as its low cost, can be powered via the Arduino UNO's 5V output, and is relatively accurate.

The distance could be calculated using the formulation below:

Total Distance D = 1/2 × T × c, Where D is the distance, T is the time between the emission and the transmission, and c is the velocity of the sonic waves. (This value is multiplied by ½ times because T is the time for the distance to go and return).

Figure 7.Ultrasonic Sensor (HC-SR04)

4.2.1Ultrasonic Sensor (HC-SR04) Features-

Ultrasound in any lighting environment is reliable, and can be used indoor or outdoor. Ultrasonic sensors used at the nearest drive-thru restaurant or bank to incorporate in grain bin sensing systems , water level sensing, drone systems and sensing vehicles.

Ultrasonic Sensors are deployed in the contact-free detection of following:

- Existence
- Levels
- Positions
- Distances

An ultrasonic sensor can detect in following difficult conditions:

Transparent object

Ultrasonic waves used can even reflect a glass or liquid surfaces, and can revert back to the sensor head, even detecting translucent aims.

Resistant to mist and dirt

Accumulation of soil or debris doesn't impair identification. And Ultrasonic sensor can even work in smoke-filled environment.

Table 4.1: Parameters of (HC: SR04)

Sr. No.		
1	Operating Voltage	5 V Direct Current
2	Operating Current	15 mA
3	Operating Frequency	40 Hz
4	Maximum Range	400 cm
5	Minimum Range	2 cm
6	Measuring Angle	15 degree
7	Trigger Input Signal	10 uS TTL pulse
7	Echo Output Signal	Input TTL lever signal and the range in proportion
9	Dimensions	45.0X20.0X15.0(In millimeters)

4.3 Buzzer/Piezo Speaker-

A 5v speaker/buzzer is electronic equipment that is used for making sounds, tone or alarm. It's a cheap in price and lightweight. Depending upon requirements of user it comes in wide variety of sizes that is employed across varying frequencies and makes various sound outputs. A piezo speaker consists of an outer case with two pins to be fastened to power and ground. There is piezo feature within the case which consists of a central ceramic disk surrounded by metal

Disks. When electrical signals of different frequencies are applied to the buzzer, this causes the disk to contract and expand which in turn causes vibration of the surrounding metal disc.

Figure 8.Buzzer/Piezo Speaker

4.3.1Buzzer Applications-

- Used in Alarming systems, security and safety equipments.
- Used as indicator for drivers.
- Used in various household appliances like washing machine, microwave and timers.
- Communication equipments and Portable equipments, due to its compact size.

CHAPTER -5: PARKING SYSTEM CIRCUIT

5.1 Circuit Diagram

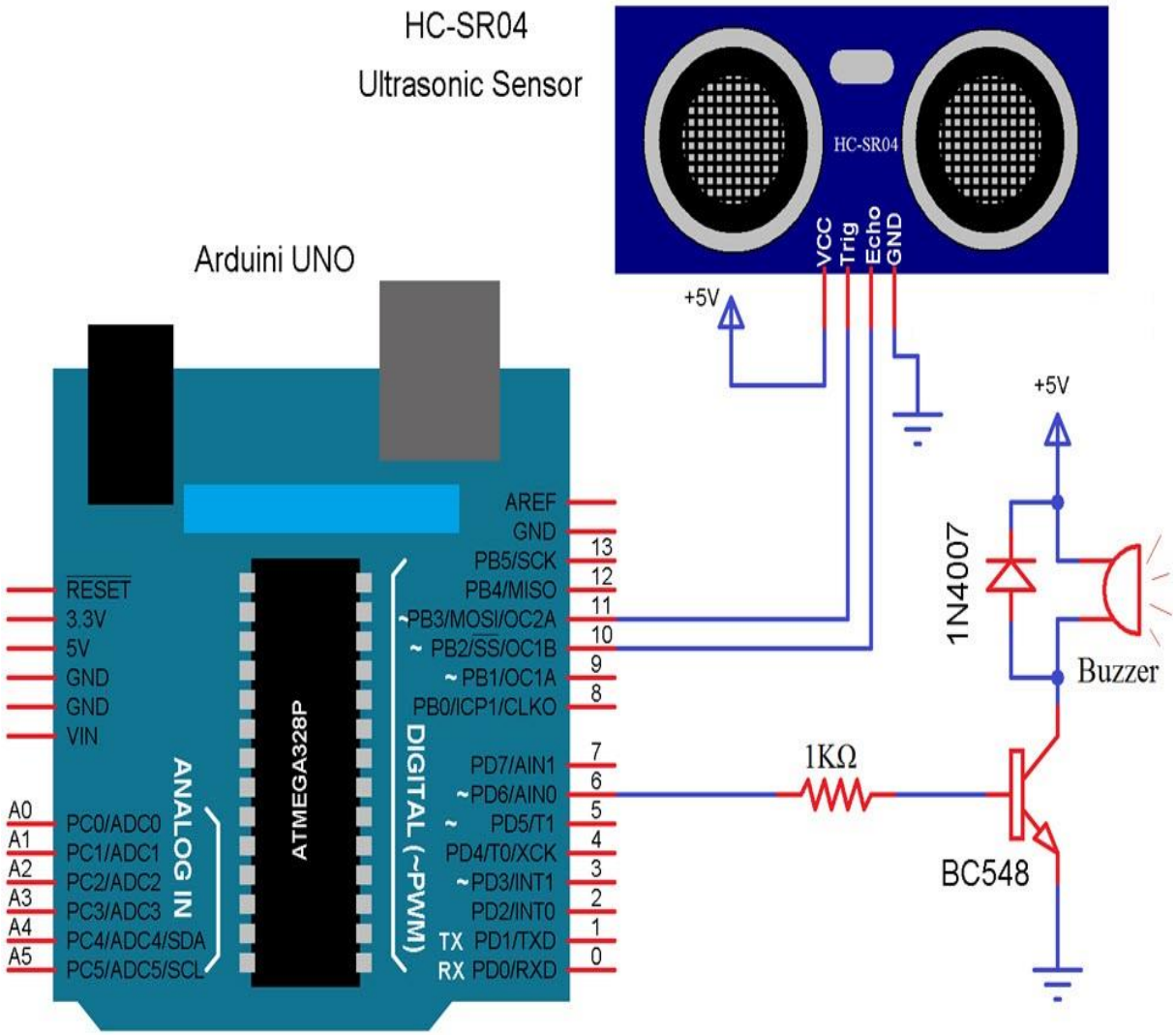

Figure 9. Car Reverse Parking System

5.2Components Needed

- Arduino UNO board
- Ultrasonic Sensor (HC-SR04)
- NPN Transistor (BC548)
- A 5V Piezo speaker/Buzzer
- P-N Junction Diode (1N4007)
- 1Kilo-ohms Resistance
- A Breadboard
- Wires for making Connections
- 5V Power Supply

5.3Principle of the Circuit

The Ultrasonic Sensor(HC-SR04) is the main component unit which is needed for space measurement. Arduino Uno serves as the central control unit monitoring the Ultrasonic Sensor, measuring the room and triggering the buzzer.

The circuit principle is as follows: The Ultrasonic Sensor delivers acoustic signals, and hence the Arduino calculates the length of each mirrored signals. Arduino then measures the distance between the objects / entity based on this point interval.

Then Arduino triggers the Buzzer when there is a space amongst both the sensor and the object less than the required for safe parking and movement. By reconfiguring our code in Arduino IDE, we can change the frequency of beeps / sound buzzers by increasing or decreasing the distance between the object.

5.3.1Designing of the Car Reverse Parking System-

The designing of the Car Reverse Parking System circuit is extremely easy task. We just need to follow below mentioned steps

First we start with the Ultrasonic Sensor, Ultrasonic sensor have 4 pins and are as following:

(i)VCC

(ii)TRIG

(iii)ECHO

(iv)GND

STEPS-

1. The VCC and GND (Ground) are connected to the power supply by +5V and GND.
2. The TRIG pin and ECHO pin are respectively connected to Arduino Digital Input/Output pin number 11 and 10.
3. The Buzzer we are using here could be a 5V buzzer, we made a decision to use an NPN Transistor driver circuit for the buzzer. We used BC548 to drive the buzzer Alongside a 1 Kilo ohms resistor (for the base).

5.3.2Working –

The working of the Car reverse parking system is simple; The Arduino will continue calculating the distance of the objects ahead of the Ultrasonic Sensor until the circuit is turned ON.

If the distance measured is less than 100 cm then Arduino will trigger the buzzer. If indeed the individual is interested then the Arduino code can be changed to activate the buzzer such that the strength of the beeping intensifies with a fall within the distance (like in automobile).

5.4APPLICATIONS–

The Arduino Smart Car Reversing Parking Sensor System can be deployed in following areas:

- Self Driving Vehicles-The Autonomous Vehicles like Waymo(Google's self-driving cars) uses this system
- Obstacle Avoiding Robots-Modern day Robots uses the principle of this system to avoid the obstacle coming in its way.
- Distance Measurement
- Proximity Detection
- Human Detection-As the ultrasonic sensor is surface independent this system can also be used to detect human bodies in the given place.
- Drones, UAVs and Helicopters- Drones, an Unmanned Aerial Vehicles (UAV'S) and advance Combat Helicopters also use advance form of this system to detect targets.

5.5 **Circuit Implementation of Car Reverse Parking System**

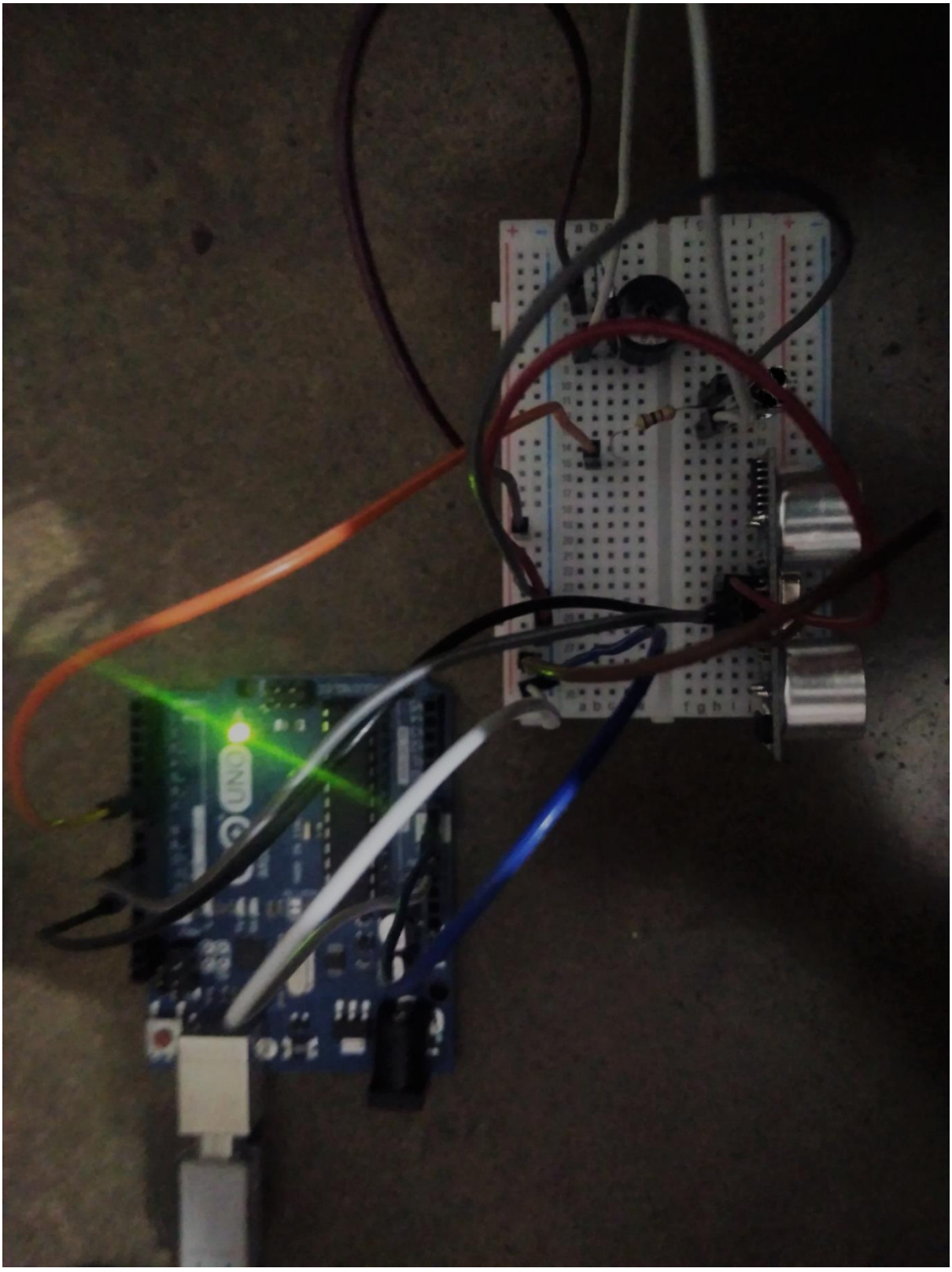

Figure 10. Car Reverse Parking System Physical Implementation

CHAPTER -6: Arduino IDE, Libraries Used

6.1 Arduino IDE-

The Arduino Integrated Development Environment (IDE) is the programming framework based and written on C++ and C procedures (for Windows OS, MacintoshOS, and Linux). Helps in writing and uploading the codes to compliant Arduino boards.

The source codes of the Arduino IDE are present under the GNU General Public Licensing, with help of special code structuring rules; the Arduino IDE recognizes the languages C and C++. The Arduino IDE also facilitates a Wiring project software library that also gives large basic techniques for input and output.

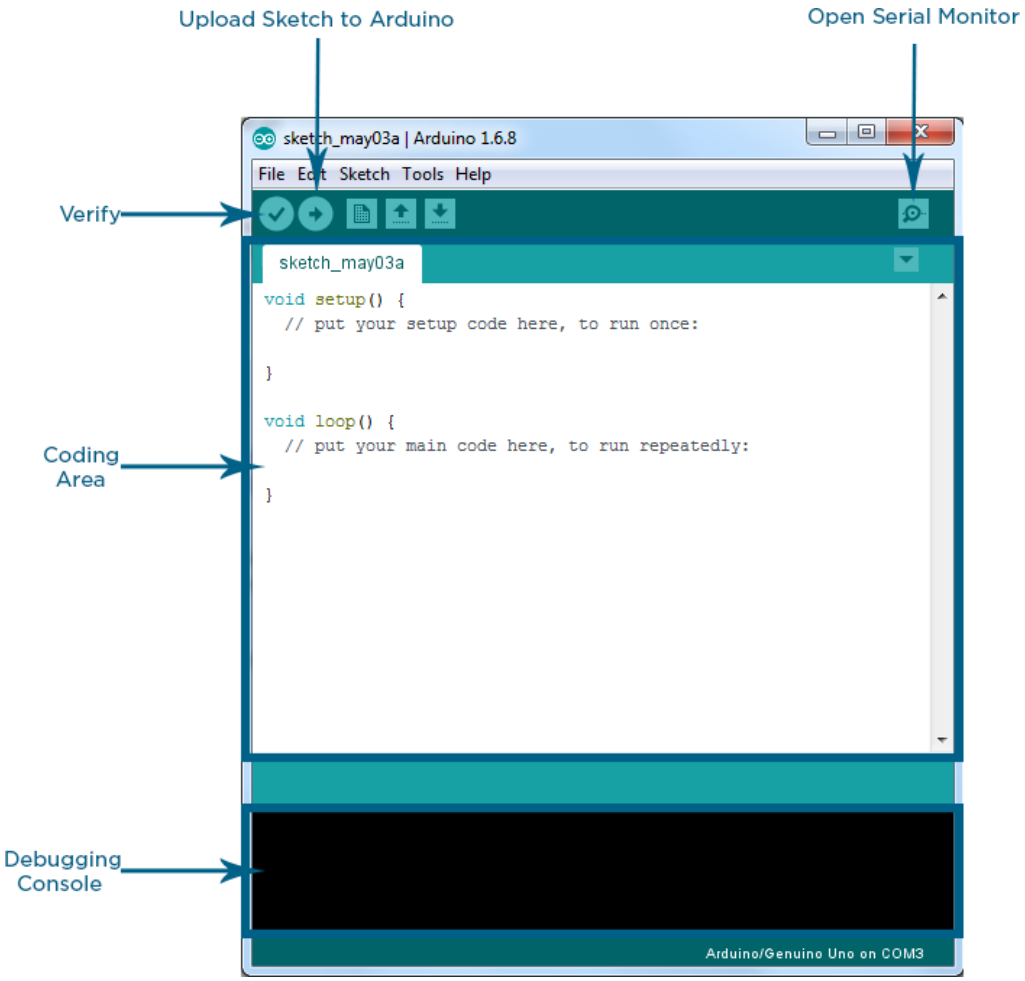

Figure 11. Arduino IDE

6.2Arduino UNO Libraries-

In programming, a library is a list of non-volatile materials that computer systems uses, mostly for the creation of applications. Those can provide details on the setup, documents, and support data, prototypes for communications, pre - built code and sub - routines, classes, attributes or parameters on the form.

Libraries are the files compiled in languages like C or C++ (.c,.cpp) that offer additional flexibility to your sketches (Power to manipulate the LED matrix, or to interpret an encoders, and various other functionalities.). These libraries have been incorporated in Arduino 0004.
To use a library in a sketch, go to Sketch > Import Library to choose it. And will include a # include statement in the header (.h) file in the library folder at the top of the sketch. Such statements make accessible to your sketch the public functions and constants identified by the libraries. They also indicate the Arduino system when it is compiled or published, to connect the code of that library to your sketch.
There are many pre-installed libraries such as-

i) EPROM
ii) GSM
iii) WIRE
iv) WIFI
v) SD
vi) ETHERNET
vii) Wi-Fi
viii) SERVO
ix) Stepper

And many more.
We can also add our own libraries by, building a folder with your library name within ARDUINO/hardware/libraries. The folder will contains the C or C++ file with the code, and a header file with your method and definitions of variables. It would then be visible on the Arduino IDE menu on the Sketch Import Library.

Since libraries are added with the sketch to the board, they raise the quantity of space the ATmega8 requires on the board. When a sketch doesn't require a library anymore, immediately remove its # include statements from header file of the codes. This would avoid the Arduino IDE from connecting the library to the sketch which will reduce the size of memory space used on the machine.

Arduino libraries we have used-

i) DHT sensor library-1.3.9

ii) Buzzer library-1.0.0

iii) Ultrasonic sensor library-3.0.0.

CONCLUSIONS

IoT-Temperature and humidity measurement systems provide an important and conclusive method for controlling the parameters of the agriculture and smart cities. Smart Reverse Parking system provides the user the precise parking space without damaging the car and surroundings. Both systems have great significance in setup of future Smart Cities.

The rightful action can be taken using both systems. IoT-Based temperature and humidity sensors provides land tracking not only helps users to minimize their work and time, it also encourages users to analyze relevant changes in the environment and to take action. The reverse car parking system saves the time, fuel and ensures the safety of driver and its surroundings. The installation both systems are very cheap in cost and consume less power. Such IoT-based systems can be developed to control multiple electronic and electrical devices from remote areas.

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APPENDIX

APPENDIX A

Code for Temperature and Humidity Measurement-

```
#include <dht.h>
#include "dht.h"
#define dht_apin 7 // Analog Pin sensor is connected to this pin number
dht DHT;
void setup(){
  Serial.begin(9600);
  delay(500);//Delay to let system boot
  Serial.println("DHT11 Humidity & temperature Sensor\n\n");
  delay(2000);//Wait Before accessing the sensor

}//ends the "setup()"

void loop(){
  //Start of  the Program

    DHT.read11(dht_apin);

    Serial.print("Current humidity = ");
    Serial.print(DHT.humidity);
    Serial.print("%  ");
    Serial.print("temperature = ");
    Serial.print(DHT.temperature);
    Serial.println("C  ");

    delay(5000);//Waits for 5 seconds before accessing sensor again.

  //Fastest should be once in every two seconds.

}// ends loop()
```

APPENDIX B

Code for Car Reverse Parking System-

```
const int trigPin = 11;
const int echoPin = 10;
const int buzzPin = 6;

long duration;
float distance;

void setup()
{
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(buzzPin, OUTPUT);
}

void loop()
{
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
  distance = 0.034*(duration/2);

  if (distance < 100)
  {
    digitalWrite(buzzPin,HIGH);
  }
  else
```

```
  {
    digitalWrite(buzzPin,LOW);
  }
  delay(300);
}
```