Internet Of Things-3171108

Name:	Enrolment No:	Semester:7

Sr. No.	Definition	Date	Signature
1	Introduction to Arduino Uno Architecture.		
2	Introduction to Raspberry Pi Architecture.		
3	GPIO Interfacing and programming Using Arduino.		
4	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.		
5	Case study - Home Automation with IoT		
6	Case study - River Water Pollution Monitorning with IoT		
7	Case study - Smart City		
8	Case study - Health care monitoring		
9	Exploring Tinkercad software.		
10	Exploring Thingspeak software.		

PRACTICAL –1

AIM: Introduction to Arduino Uno Architecture.

What is Arduino?

- Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.
- Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.
- Arduino was born at the Vireo Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

Why Arduino?

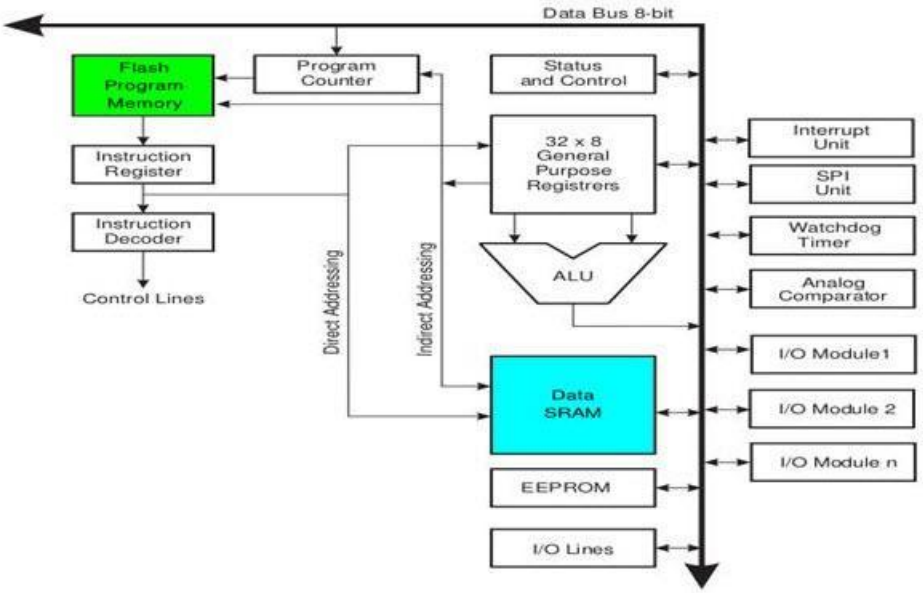
- Thanks to its simple and accessible user experience, Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics.
- Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.
- There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package.

Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- **Inexpensive** -
  - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50
- **Cross-platform** -
  - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
  - Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.
- **Open source and extensible software** -
  - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- **Open source and extensible hardware** -
  - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

Arduino Architecture:

Basically, the processor of the Arduino board uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories such as program memory and data memory. Wherein the data is stored in data memory and the code is stored in the flash program memory. The Atmega328 microcontroller has 32kb of flash memory, 2kb of SRAM 1kb of EPROM and operates with a 16MHz clock speed.

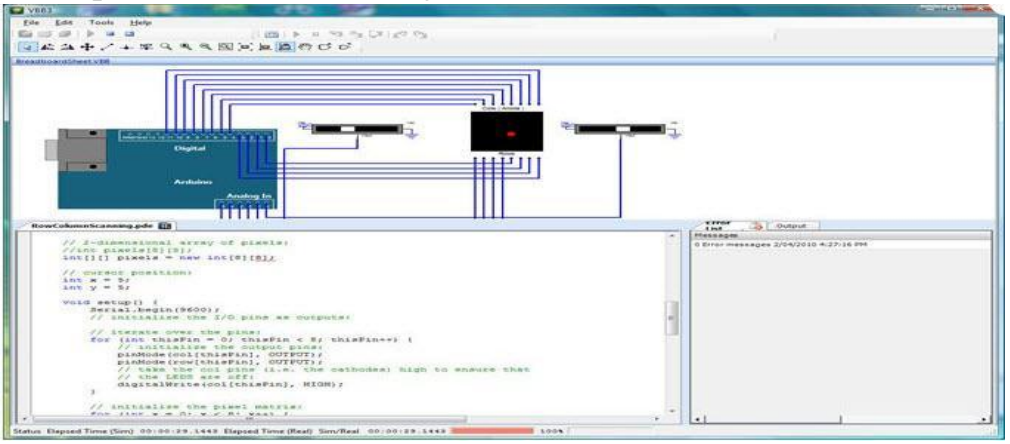


Arduino Architecture

How to program an Arduino?

The main advantage of the Arduino technology is, you can directly load the programs into the device without the need of a hardware programmer to burn the program. This is done because of the presence of the 0.5KB of boot loader, that allows the program to be dumped into the circuit.

The Arduino tool window contains a toolbar with a various buttons like new, open, verify, upload and serial monitor. And additionally it comprises of a text editor (employed to write the code), a message space (displays the feedback) like showing the errors, the text console, that displays the o/p & a series of menus just like the file, tool menu & edit.



Arduino Program

- Programming into the Arduino board is called as sketches. Each sketch contains of three parts such as Variables Declaration, Initialization and Control code. Where, Initialization is written in the setup function and Control code is written in the loop function.
- The sketch is saved with .ino and any operation like opening a sketch, verifying and saving can be done using the tool menu.
- The sketch must be stored in the sketchbook directory.
- Select the suitable board from the serial port numbers and tools menu.
- Select the tools menu and click on the upload button, then the boot loader uploads the code on the microcontroller.

Basic Functions of Arduino Technology:

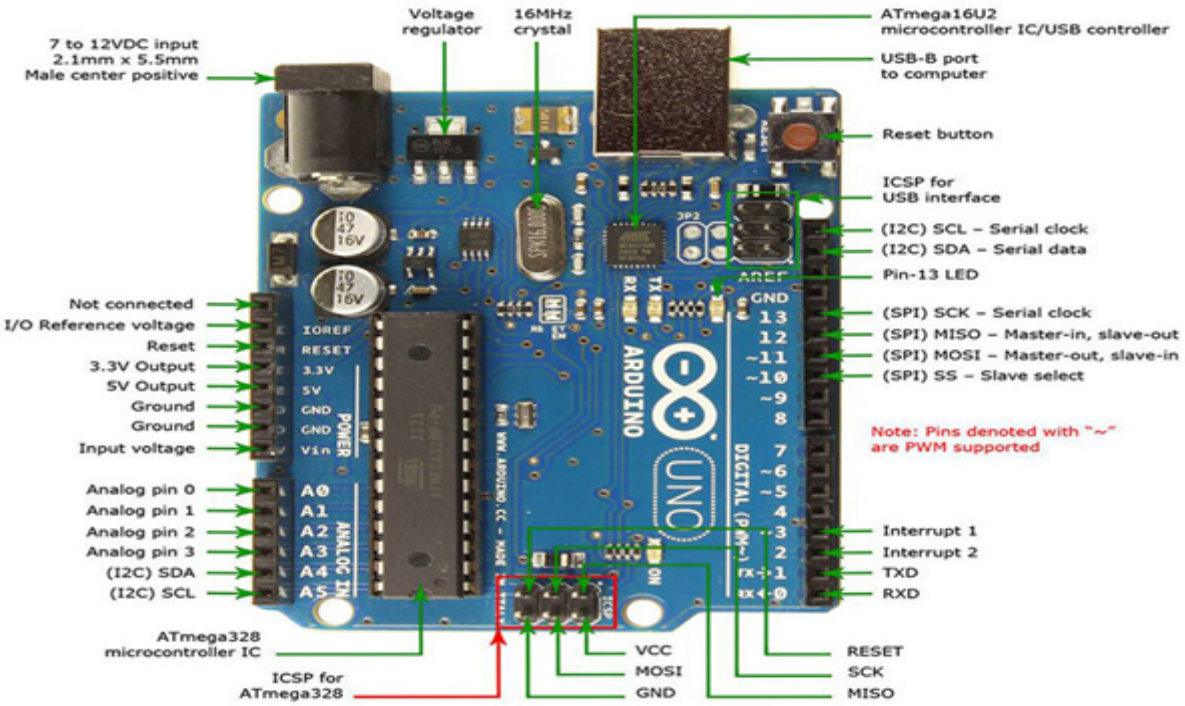
- Digital read pin reads the digital value of the given pin.
- Digital write pin is used to write the digital value of the given pin.
- Pin mode pin is used to set the pin to I/O mode.
- Analog read pin reads and returns the value.
- Analog write pin writes the value of the pin.
- Serial. Begins pin sets the beginning of serial communication by setting the rate of bit.

Advantages of Arduino Technology:

- It is cheap
- It comes with an open supply hardware feature that permits users to develop their own kit
- The software of the Arduino is well-suited with all kinds of in operation systems like Linux, Windows, and Macintosh, etc.
- It also comes with open supply software system feature that permits tough software system developers to use the Arduino code to merge with the prevailing programming language libraries and may be extended and changed.
- For beginners, it is very simple to use.

Arduino Uno Board with Real-Time Application Projects:

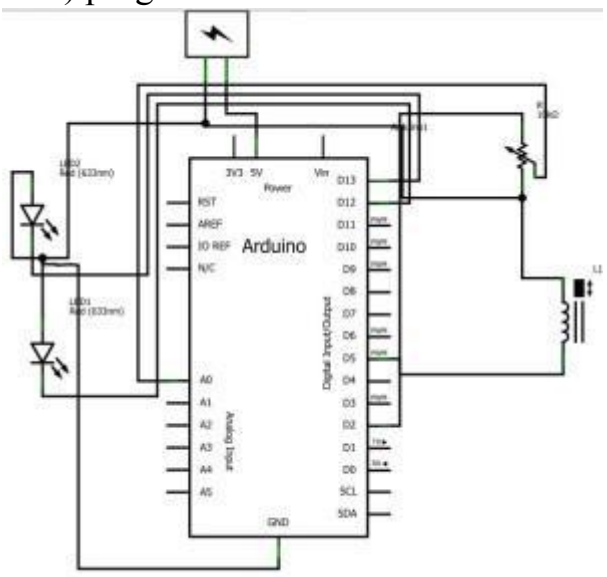
Arduino is a single-board microcontroller meant to make the application more accessible which are interactive objects and its surroundings. The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. Current models consists a USB interface, 6 analog input pins and 14 digital I/O pins that allows the user to attach various extension boards.



Arduino Uno Board

The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller.

In order to get started, they are simply connected to a computer with a USB cable or with an AC-to-DC adapter or battery. Arduino Uno Board varies from all other boards and they will not use the FTDI USB-to-serial driver chip in them. It is featured by the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.



Arduino Uno with Digital Input/output

There are various types of Arduino boards in which many of them were third-party compatible versions. The most official versions available are the Arduino Uno R3 and the Arduino Nano V3. Both of these run a 16MHz Atmel ATmega328P 8-bit microcontroller with 32KB of flash RAM 14 digital I/O and six analogues I/O and the 32KB will not sound like as if running Windows. Arduino projects can be stand-alone or they can communicate with software running on a computer. For e.g. Flash, Processing, and Max/MSP). The board is clocked by a 16 MHz ceramic resonator and has a USB connection for power and communication. You can easily add micro SD/SD card storage for bigger tasks.

PRACTICAL – 2

AIM: Introduction to Raspberry Pi Architecture.

Introduction:

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries.
The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards, mice and cases). However, some accessories have been included in several official and unofficial bundles.
According to the Raspberry Pi Foundation, over 5 million Raspberry Pi's were sold by February 2015, making it the best-selling British computer.[8] By November 2016 they had sold 11 million units, and 12.5m by March 2017, making it the third best-selling "general purpose computer".In July 2017, sales reached nearly 15 million.
Several generations of Raspberry Pis have been released. All models feature a Broadcom system on a chip (SoC) with an integrated ARM compatible central processing unit (CPU) and on-chip graphics processing unit (GPU).
Processor speed ranges from 700 MHz to 1.2 GHz for the Pi 3; on-board memory ranges from 256 MB to 1 GB RAM. Secure Digital (SD) cards are used to store the operating system and program memory in either SDHC or MicroSDHC sizes.

Why you should use one:

- Low cost and low power
- Simple to use
- Educational device for youths and hobbyists to learnabout programming
- Versatile for many different projects/applications
- Compact Size
- Immense amount of resources for different projects

Hardware:

- 4 Models: A, A+, B, B+
- 85.6mm x 56mm x 21mm
    - The size of your student ID

- ARM1176JZF-S Processor
    - Typical clock size is 700 MHz, preforming at approximately 40
- MFLOPS
    - Can be over clocked to 1GHz without any issues
- Includes Video Core IV graphics processor w/ 1 billion pixels per second
- 512 MB of RAM is built into the board, not replaceable or upgradeable
- Includes multiple built on I/O ports
    - 100 MB/s Ethernet port
    - HDMI port and RCA port
    - Audio Jack

RISC Architecture:

- Low Transistor Count
- Low Power Consumption/Heat Production
- Used in most mobile devices
    - Phones
    - Laptops
    - Small Digital Devices
- Raspberry Pi has similar requirements to
    - mobile devices
- Architecture allows for various Unix OSs
    - Raspberry Pi can utilizes nearly all Linux distros

Instruction Set:

- 3 Instruction Sets
    - 32 Bit ARM
        - § Single Instructions
        - § Handles Data
        - § Organizes Processor Segments
    - 16 Bit Thumb
        - § Specialize in branch range and address space

        - § Used with ARM for rapid interrupts
        - § Used for Digital Signal Processing
    - 8 Bit Java
        - § Jazelle Technology
        - § Deals with complex Java byte codes

Pipelining:

· 8 stage pipeline

· Data path consists of three pipelines:
    - ALU, shift, or Sat pipeline
    - MAC pipeline
    - Load or store pipeline

· Fetch stages can hold up to four instructions. Branch predictionperformed on instructions ahead of execution of earlier instructions

· Issue and Decode stages can contain any instruction in parallel with apredicted branch

· Execute, Memory, and Write stages can contain a predicted branch, anALU, or multiply instruction load/store multiple instruction, and acoprocessor instruction in parallel execution.

Pipeline Stages:

The Raspberry Pi Components:
The Raspberry Pi device looks like a motherboard, with the mounted chips and ports exposed (something you'd expect to see only if you opened up your computer and looked at its internal boards), but it has all the components you need to connect input, output, and storage devices and start computing.
You'll encounter two models of the device: Model A and Model B. The only real differences are the addition of Ethernet and an extra USB port on the more expensive Model B.

Components on the Raspberry Pi board:

· ARM CPU/GPU -- This is a Broadcom BCM2835 System on a Chip (SoC) that's made up of an ARM central processing unit (CPU) and a Videocore 4 graphics processing unit (GPU). The CPU handles all the computations that make a computer work (taking input, doing calculations and producing output), and the GPU handles graphics output.

- GPIO -- These are exposed general-purpose input/output connection points that will allow the real hardware hobbyists the opportunity to tinker.
- RCA -- An RCA jack allows connection of analog TVs and other similar output devices.
- Audio out -- This is a standard 3.55-millimeter jack for connection of audio output devices such as headphones or speakers. There is no audio in.
- LEDs -- Light-emitting diodes, for all of your indicator light needs.
- USB -- This is a common connection port for peripheral devices of all types (including your mouse and keyboard). Model A has one, and Model B has two. You can use a USB hub to expand the number of ports or plug your mouse into your keyboard if it has its own USB port.
- HDMI -- This connector allows you to hook up a high-definition television or other compatible device using an HDMI cable.
- Power -- This is a 5v Micro USB power connector into which you can plug your compatible power supply.
- SD cardslot -- This is a full-sized SD card slot. An SD card with an operating system (OS) installed is required for booting the device. They are available for purchase from the manufacturers, but you can also download an OS and save it to the card yourself if you have a Linux machine and the wherewithal.
- Ethernet -- This connector allows for wired network access and is only available on the Model B.

Programming on a Pi:

- Raspberry Pi supports multiple Linux distributions
  - Ubuntu
  - Openelec
  - OSMC
- The installed ARMv6 also handle many languages
  - Python
  - C
  - C++

    - Java
    - Ruby
    - Scratch

- More programming languages can be installed with proper support tools

Applications:

While originally used to teach kids about programming, the Raspberry Pi has evolved to be used for a multitude of different applications

- Automated Light Control System
- Game System Emulator
- Surveillance System
- Universal Remote Control system
- Automated House system
- Music Streaming Speakers

PRACTICAL – 3

AIM: GPIO Interfacing and programming Using Arduino.

a) LED Blink program :

```
void setup() {
        pinMode(8,OUTPUT);
}

void loop() {
        digitalWrite(8,HIGH);
        delay(1000);
        digitalWrite(8,LOW);
        delay(1000);
}
```

b) Blink LED five times and the off it permanently :

```
void setup() {
        pinMode(8,OUTPUT);
blinked();
        digitalWrite(8,LOW);
}
void blinked(){
for(inti=0;i<5;i++) {
        digitalWrite(8,HIGH);
        delay(1000);
digitalWrite(8,LOW);
delay(1000);  }}
```

(c) Binary Counter :

```
int led2 = 5;
int led1 = 4;
int led0 = 3;
void setup() {
pinMode(led0, OUTPUT);
pinMode(led1, OUTPUT);
pinMode(led2, OUTPUT);
Serial.begin(9600);
}
void loop() {
reset();
for(inti = 0; i< 8; ++i)
  {
signal( led2, ((i>> 2) % 2) == 1);
signal( led1, ((i>> 1) % 2) == 1);
signal( led0, ((i>> 0) % 2) == 1);
delay(2000);
  }
}
void reset() {
signal( led2, 0);
signal( led1, 0);
signal( led0, 0);
}
void signal(int led, bool on) {
if(on) {
```

```
digitalWrite(led, HIGH);
  }
else {
digitalWrite(led, LOW);
  }
}
```

d) Traffic Light :

```
int GREEN = 3;
int YELLOW = 4;
int RED = 5;
void setup(){
pinMode(GREEN, OUTPUT);
pinMode(YELLOW, OUTPUT);
pinMode(RED, OUTPUT);
}
void loop(){
digitalWrite(GREEN, HIGH);
digitalWrite(YELLOW, LOW);
digitalWrite(RED, LOW);
delay(1000);
digitalWrite(GREEN, LOW);
digitalWrite(YELLOW, HIGH);
digitalWrite(RED, LOW);
delay(1000);
digitalWrite(GREEN, LOW);
digitalWrite(YELLOW, LOW);
```

```
digitalWrite(RED, HIGH);
delay(1000);
}
```

e) Buzzer :

```
constint buzzer=9;
void setup()
{
        Serial.begin(9600);
        pinMode(buzzer,OUTPUT);
}
void loop()
{
        inti=digitalRead(9);
        Serial.println(i);
        tone(buzzer,1000);
        delay(1000);
        noTone(buzzer);
        delay(1000);
}
```

Practical-4

Aim: To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.

Analog sensor programming and uploading sensor data on cloud

Description:

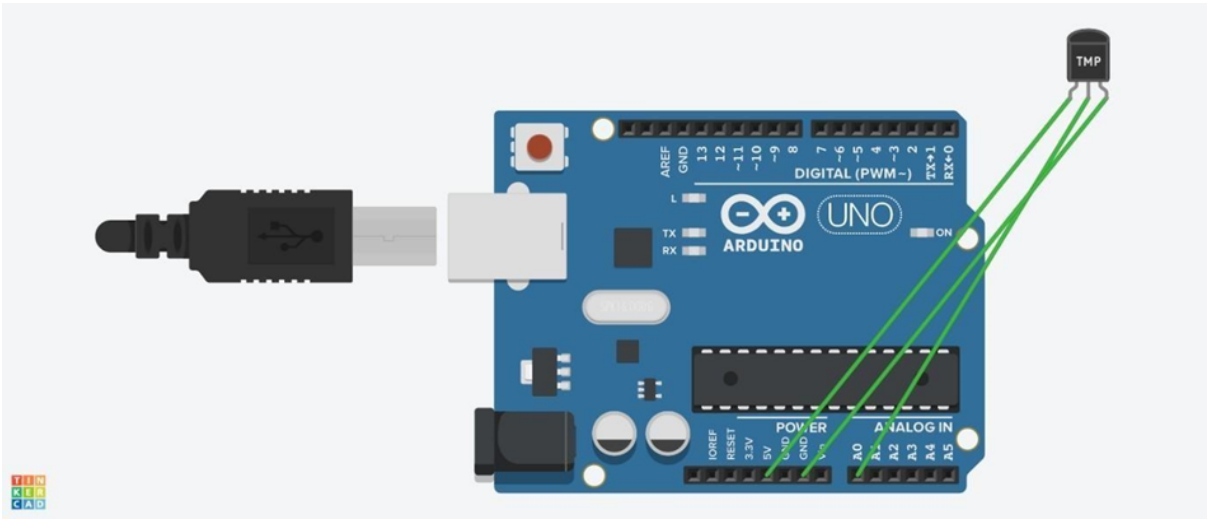
Materials used:

- **Arduino UNO Rev3**
- **Temperature Sensor**

Arduino Uno Board: The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output(I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

Temperature Sensor: The TMP36 is a low voltage, precision centigrade temperature sensor. It provides a voltage output that is linearly proportional to the Celsius temperature. It also doesn't require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the −40°C to +125°C temperature range.

Structure of Circuit:



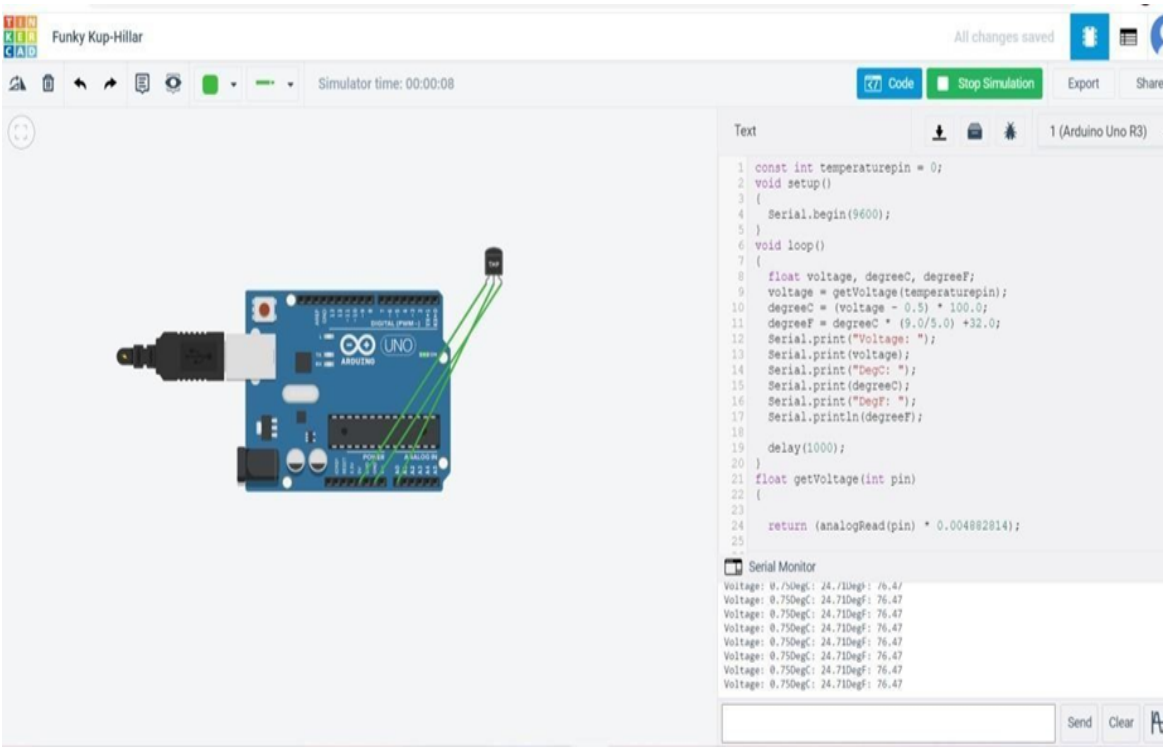
Procedure:

- **First select Arduino board and Temperature Sensor(TMP36) and place them next to each other.**
- **Connect the power pin to the 5V pin in the board.**
- **Connect ground pin to GRND pin and Vout pin to the A0 analog pin.**

Code:

```
const int temperaturepin = 0; void setup()
{
  Serial.begin(9600);
}
void loop()
{
  float voltage, degreeC, degreeF; voltage =
  getVoltage(temperaturepin);  degreeC =
  (voltage - 0.5) * 100.0;

   degreeF = degreeC * (9.0/5.0) +32.0;
  Serial.print("Voltage: "); Serial.print(voltage);
  Serial.print("DegC: "); Serial.print(degreeC);
  Serial.print("DegF: "); Serial.println(degreeF);



  delay(1000);
}
float getVoltage(int pin)
{

  return (analogRead(pin) * 0.004882814);
}
```

Output:



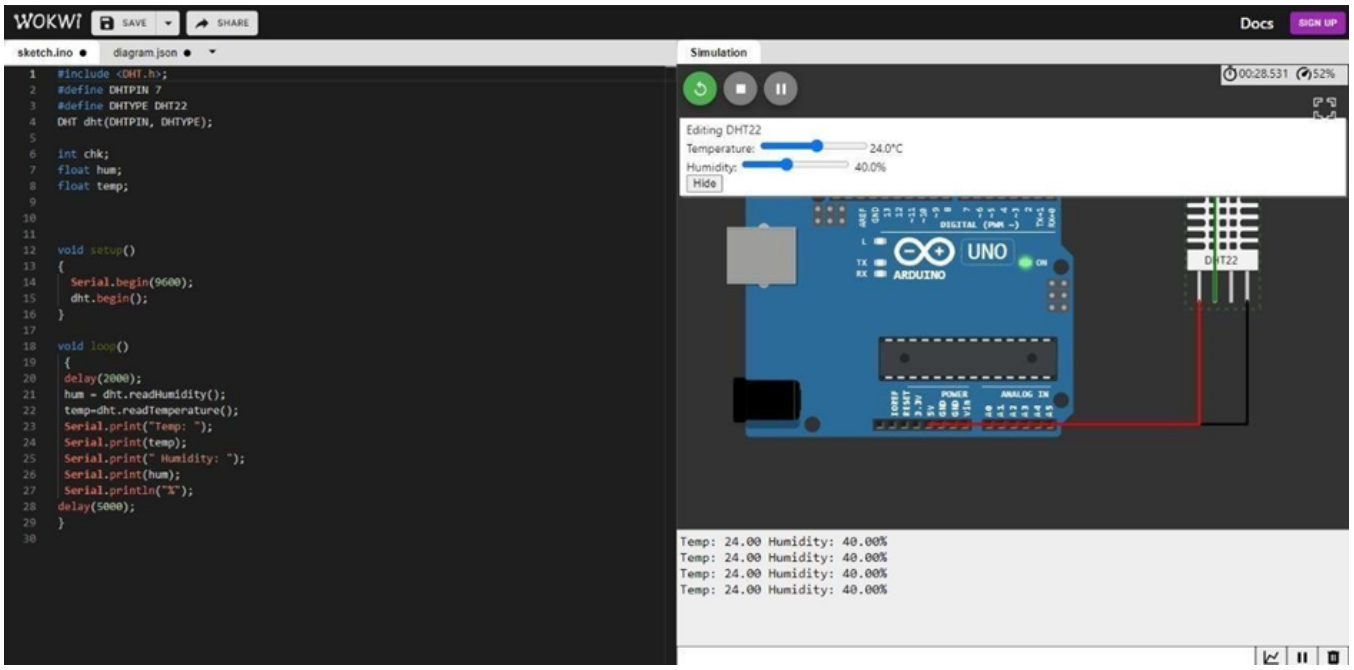
Here we can see the readings of Voltage, Celsius temperature and Fahrenheit Temperature in serial monitor below the code.

DHT22 - DHT22 output calibrated digital signal. It utilizes exclusive digital-signal- collecting-technique and humidity sensing technology, assuring its reliability and stability.Its sensing elements is connected with 8-bit single-chip computer. Every sensor of this model is temperature compensated and calibrated in accurate calibration chamber and the calibration-coefficient is saved in type of programme in OTP memory, when the sensor is detecting, it will cite coefficient from memory. Small size & low consumption & long transmission distance(20m) enable DHT22 to be suited in all kinds of harsh application occasions

Input :

```
#include <DHT.h>;
  //Constants
  #define DHTPIN 7 // what pin we're connected
  to #define DHTTYPE DHT22 // DHT 22
  (AM2302)
  DHT dht(DHTPIN, DHTTYPE); //// Initialize DHT sensor for normal 16mhz Arduino
// Variables
int chk;
float hum; //Stores humidity value
float temp; //Stores temperature value
void setup()
{
Serial.begin(9600); dht.begin();
}

void loop()
{
delay(2000);
//Read data and store it to varialbles hum and temp hum = dht.readHumidity();
temp= dht.readTemperature();
//Print temp and humidity values to serial monitor Serial.print("Temp: ");
Serial.print(temp);
Serial.print(" C |");
Serial.print("Humidity: ");
Serial.print(hum);
Serial.print("%"); delay(5000);}
```

OUTPUT:



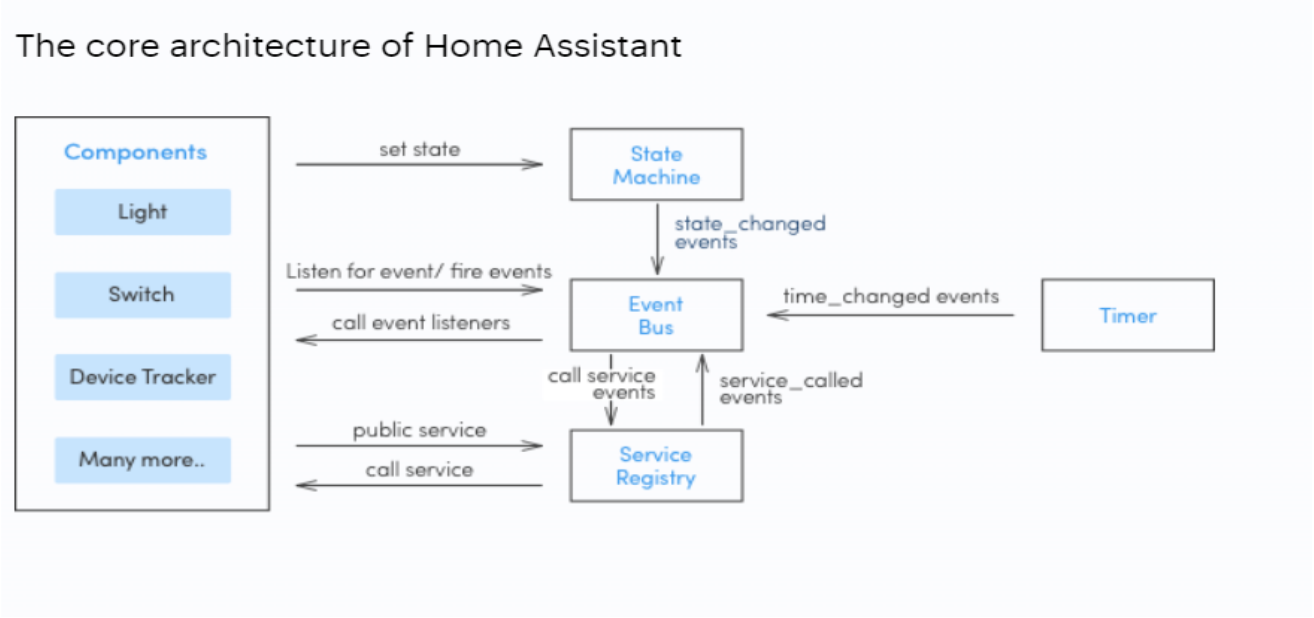
Conclusion:

Hence we have completed the experiment for printing temperature and humidity readings using the temperature sensor.

Practical-5

Aim: : **Case study - Home Automation with IoT**

- Home automation is constructing automation for a domestic, mentioned as a sensible home or smart house. In the IoT home automation ecosystem, you can control your devices like light, fan, TV, etc.
- A domestic automation system can monitor and/or manage home attributes adore lighting, climate, enjoyment systems, and appliances. It is very helpful to control your home devices.
- It's going to in addition incorporates domestic security such as access management and alarm systems. Once it coupled with the internet, domestic gadgets are a very important constituent of the Internet of Things.
- A domestic automation system usually connects controlled devices to a central hub or gateway.
- The program for control of the system makes use of both wall-mounted terminals, tablet or desktop computers, a smartphone application, or an online interface that may even be approachable off-site through the Internet. Smart Home Components : Here, you will see the smart home components like smart lighting, smart appliances, intrusion detection, smoke/gas detector, etc. So, let's discuss it



Component-1 :

Smart Lighting –

- Smart lighting for home helps in saving energy by adapting the life to the ambient condition and switching on/off or dimming the light when needed.
- Smart lighting solutions for homes achieve energy saving by sensing the human movements and their environments and controlling the lights accordingly.

Component-2 :

Smart Appliances –

- Smart appliances with the management are here and also provide status information to the users remotely.
- Smart washer/dryer can be controlled remotely and notify when the washing and drying are complete.
- Smart refrigerators can keep track of the item store and send updates to the users when an item is low on stock.

Component-3 :

Intrusion Detection –

- Home intrusion detection systems use security cameras and sensors to detect intrusion and raise alerts.
- Alert can we inform of an SMS or an email sent to the user.
- Advanced systems can even send detailed alerts such as an image shoot or short video clips.

Component-4 :

Smoke/gas detectors –

- Smoke detectors are installed in homes and buildings to detect smoke that is typically an early sign of Fire.
- It uses optical detection, ionization for Air sampling techniques to detect smoke.
- Gas detectors can detect the presence of harmful gases such as CO, LPG, etc.
- It can raise alerts in the human voice describing where the problem is.

Practical-6

Aim: : **Case study - River Water Pollution Monitoring with IoT**

Introduction :-

The environment consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms. Among these water is the utmost crucial element for human life. It is also vital for the persistence of other living habitats. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is the need for public health. So it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health of the humans and at the same time affect the ecological balance among other species. Water pollution is a foremost global problem which needs ongoing evaluation and adaptation of water resource directorial principle at the international levels of international water sources down to individual wells. water is being used for drinking without any proper prior treatment. One of the reasons for this happening is the ignorance of the public and administration and the lack of a water quality monitoring system which causes serious health issues.

So, we depict the design of Wireless Sensor Network (WSN) that assists to monitor the quality of water with the support of information sensed by the sensors dipped in water. Using different sensors, this system can collect various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature, and so on. The rapid development of WSN technology provides a novel approach to real-time data acquisition, transmission, and processing. The clients can get ongoing water quality information from far away.

Now a day's Internet of things (IoT) is an innovative technological phenomenon. It is shaping today's world and is used in different fields for collecting, monitoring and analysis of data from remote locations. IoT integrated network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable. Though IoT is still under-applicated in the field of environment it has huge potential. It can be implemented in the field of water quality monitoring and controlling systems.

Water quality monitoring has gained more interest among researchers in this twenty-first century. Numerous works are either done or ongoing in this topic focusing on various aspects of it. The key theme of all the projects was to develop an efficient, cost-effective, real-time water quality monitoring system which will integrate wireless sensor network and internet of things. In this research, we monitor the physical and chemical parameters of water bodies inside Chittagong city by using an IoT based sensor network.

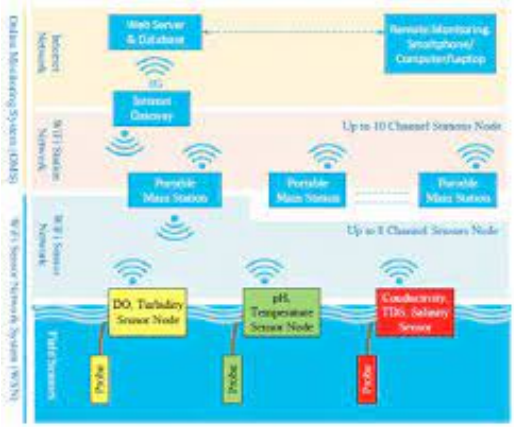
Related works :-

To design a good quality model, we reviewed out different existing system developed by researchers. Different authors have proposed distinguished models to check water quality by analyzing the parameters such as temperature, pH and conductivity, and so on. By considering all these points, we designed a smart water monitoring system which can perform all these monitoring functions. Stephen Brosnan investigated a WSN to collect real time water quality parameters (WQP). The information was sent by means of GPRS network, which helped to check remotely the WQP. Kamal Alameh presented web based WSN for monitoring water pollution using ZigBee and WiMAX networks. The system collected, processed measured data from sensors, and directed through ZigBee gateway to the web server by means of WiMAX network to monitor quality of water from large distances in real time. Dong He developed WQM system based on WSN. The remote sensor was based on ZigBee network. WSN tested WQP and sent data to Internet using GPRS. With the help of Web, information was gathered at remote server. The parameters such as turbidity, temperature, pH, dissolved oxygen conductivity of water can be. Proposed system The main aim is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost and high detection accuracy. pH, conductivity,e measured. In our practical, we proposed a water quality monitoring system based on IoT.

Proposed system :-

The main aim is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost and high detection accuracy. pH, conductivity, turbidity level, etc. are the limits that are analyzed to improve the water quality.

(a) To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc. using available sensors at a remote place. (b) To assemble data from various sensor nodes and send it to the base station by the wireless channel. (c) To simulate and evaluate quality parameters for quality control. (d) To send SMS to an authorized person routinely when water quality detected does not match the preset standards, so that necessary actions can be taken.The detailed scheme of a water quality monitoring system is shown in Figure.



In the proposed architecture, each water reservoir will be attached with a sensor node equipped with a set of sensor probes capable of measuring the parameters like pH, turbidity etc.

Sensors for monitoring

1. pH sensor

The pH of thing is a useful constant to display because graduate and low pH levels can hump large effects on the author. The pH of a statement can grasp from 1 to 14. A pH sensor is an instrumentation that measures the hydrogen-ion density in a bleach, indicating its tartness or alkalinity. Its constitute varies from 0 to 14 pH.

pH values also process the solubility of elements and compounds making them cyanogenetic. Mathematically pH is referred as, pH = -log [H+].

2. Turbidity sensor

Turbidity train sensor is victimised to measure the clarity of element or muddiness utter in the water. The muddiness of the open cut food is ordinarily between 255 NTU. Irrigate is visibly at levels above 80 NTU. The standards for intemperance liquid is 130 NTU to 250 NTU. The turbidity device consists of soft sender and acquirer, the transmitter needs to transmit unsubtle bright, it is said to be turbid. The consequence of turbidity is a reduction in water clarity, aesthetically unpleasant, decreases the rate of photosynthesis, increases water temperature.

3. Temperature sensor

Here DS18B20 is old as the temperature device. Usually, its present use to perceive the temperature of the life, if we site the device wrong the conductor electrode and placed into

the H2O, it can discover the temperature of H2O also. The normal temperature of the people is (25 -30)°C.

4. LCD display

LCD (Liquid Crystal Display) impede is a flat brace electronic exhibit power and finds in a countywide orbit of applications. A 16x2 LCD demo is the really fundamental power and is rattling commonly victimised in varied devices and circuits. These modules are desirable over heptad segments and otherwise multi-segment LEDs.

5. Wi-Fi module

Wi-Fi or Wi-Fi is a subject for wireless localized area scheme with devices. Devices that can use Wi-Fi study permit private computers, video-game consoles, smartphones, digital cameras, paper computers, digital frequency players and ultramodern printers. Wi-Fi matched devices can insert to the Cyberspace via a LAN web and wireless make a bushel. Much a reach quantity (or point) has a capableness of around 20 meters (66 feet) indoors and a greater compass outdoors. Wi-Fi subject may be utilised to render the Internet reach to devices that are within the capability of a wireless meshwork that is connected to the Internet.

Software design

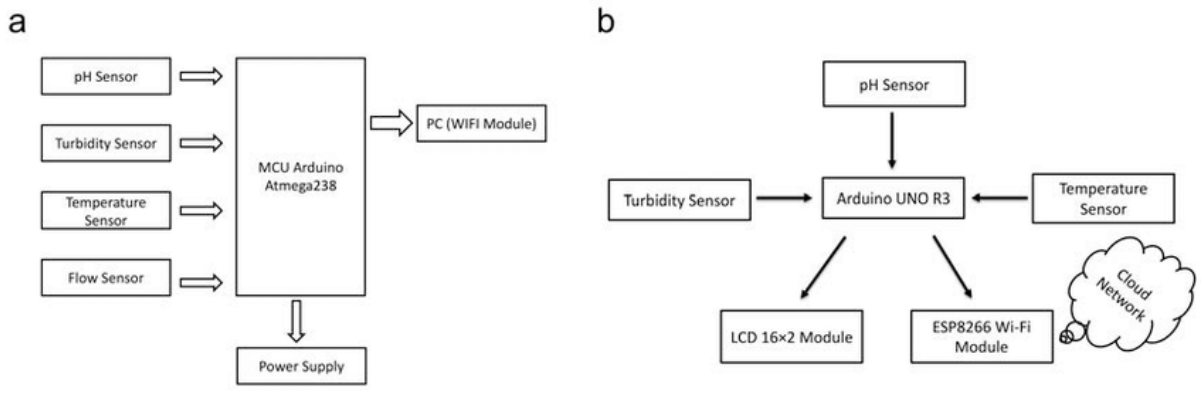
The proposed water quality monitoring system based on WSN can be divided into three parts:

• IoT platform

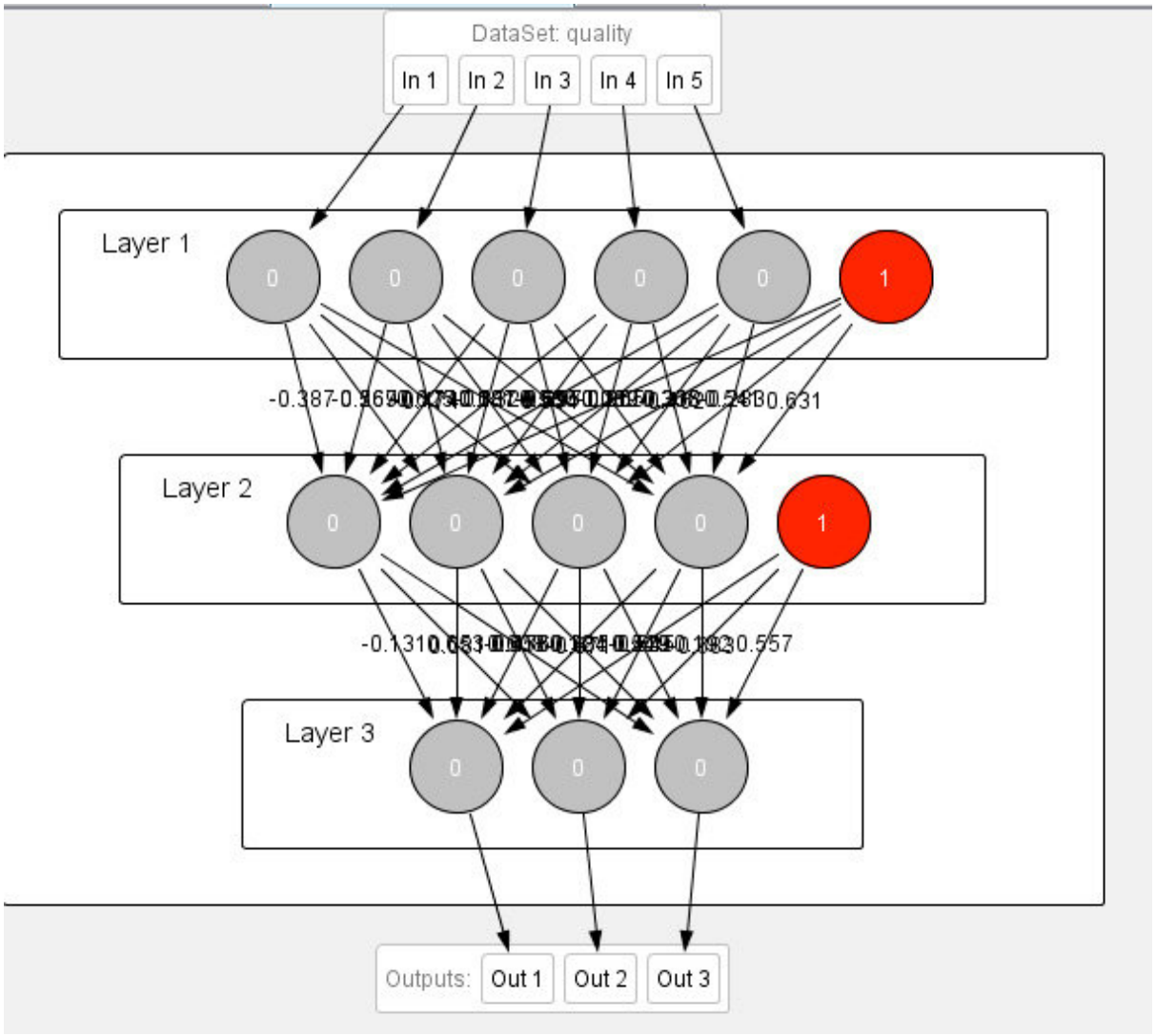
• Neural network models in Big Data Analytics and water quality management

• Real-time monitoring of water quality by using IoT integrated Big Data Analytics

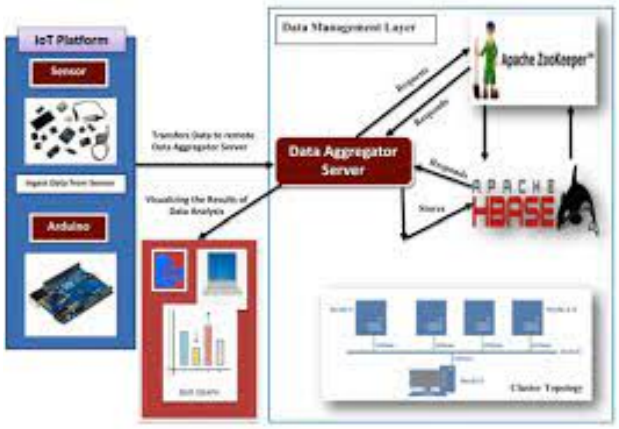
1. IoT Platform



2. Neural network models in Big Data Analytics and water quality management



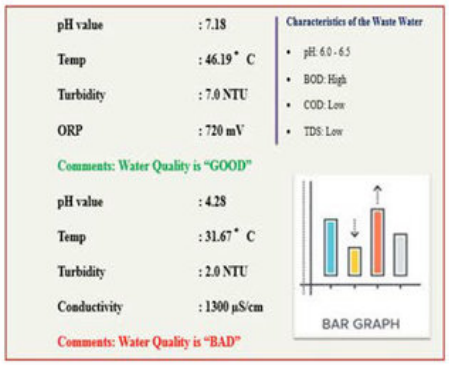
3. Real-time monitoring of water quality by using IoT integrated Big Data Analytics



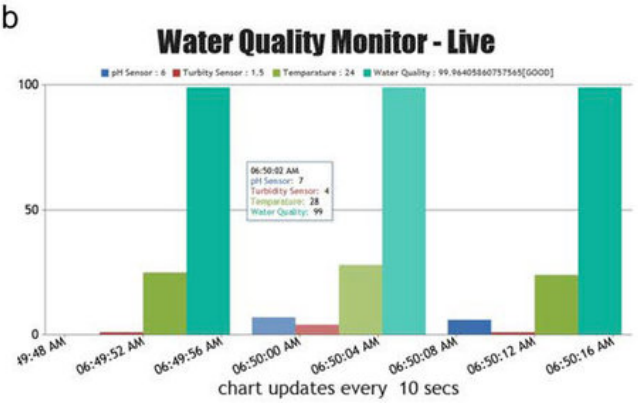
Results

we are displaying the resulting sensed pH, temp, turbidity, and ORP values. It continuously senses the values of pH, temp, turbidity, and ORP and the resulting values are displayed to the LCD, PC or mobile in real-time. If the acquired value is above the threshold value comments will be displayed as ‘BAD’. If the acquired value is lower than the threshold value comments will be displayed as ‘GOOD’. A bar/line graph will also be shown for perfect understanding. If the acquired value is above the threshold value comments will be displayed as ‘BAD’. If the acquired value is lower than the threshold value comments will be displayed as ‘GOOD’. A bar/line graph will also be shown for perfect understanding. (b) The time series representation of sensor data with decision.

a



b



Practical-7

Aim: : **Case study - Smart City**

INTRODUCTION

As the global population continues to grow at a steady pace, more and more people are moving to cities every day. Cities accommodate nearly 31% of India's current population and contribute 63% of GDP (Census 2011). Urban areas are expected to house 40% of India's population and contribute 75% of India's GDP by 2030. This requires comprehensive development of physical, institutional, social and economic infrastructure. All are important in improving the quality of life and attracting people and investment, setting in motion a virtuous cycle of growth and development. Development of Smart Cities is a step in that direction.

Smartness in city means smart design, smart utilities, smart housing, smart mobility, and smart technology. There is need for the cities to get smarter to manage complexity, increase efficiency, reduce expenses, and improve quality of life. Smart Cities focus on their most pressing needs and on the greatest opportunities to improve lives. They tap a range of approaches - digital and information technologies, urban planning best practices, public-private partnerships, and policy change - to make a difference. They always put people first.

In the approach to the Smart Cities Mission, the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions. The focus is on sustainable and inclusive development and the idea is to look at compact areas, create a replicable model, which will act like a lighthouse to other aspiring cities.

Smart Cities Mission Strategies

Pan-city initiative in which at least one Smart Solution is applied city-wide

Develop areas step-by-step – three models of area-based developments

Retrofitting,

Redevelopment,

Greenfield

OBJECTIVE OF STUDY:

The study mainly focuses an effective analysis of SWOT based on the smart city, to promote the sustainable development of urban development of the mentioned cities.

SWOT analysis of Dehradun

Strengths

1. Strategic location: Dehradun is strategically located and has good connectivity to New Delhi by air, rail and road. It serves as gateway for the key tourist destinations of state. The floating population recorded for Dehradun is 20,000 people per day.

(Source: city development plan, 2015)

2. City of Schools: Dehradun is an important educational hub of India embraced with large number of leading public schools and colleges in both government and private sector with over 1.70 lakh students enrolled. Dehradun is considered as the citadel of prestigious public schools such as The Doon School, Welham Girls & Boys School, Convent of Jesus & Mary, Rashtriya Indian Military College.

3. Literacy rate: The average literacy rate is over 84%, which is much higher than the national average of 74%. This augments the quality of human resource available in the city

4. Dehradun is anchor to organizations of national importance viz. Geological Survey of India, Wadia Institute of Himalayan Geology, Indian Institute of Remote Sensing, Forest Research Institute, Indian Military Academy and Headquarters of ONGC, Survey of India

5. Colonial age heritage structures viz. Astley hall, Clock tower (hexagonal form), Jesus Mary Church, Forest Research Institute (FRI), IMA, Khalanga

War memorial. Ashoka's Rock Edict (under ASI) & Ashwamedh Sthal of Raja Sheel Barman (Under ASI).

Weaknesses

1. Less than expected level of urban utilities: While the DMC has been taking initiatives towards SWM and sanitation issues, but the identified municipal services are below the expected level to cater to ever increasing migration.

2. High Population Density: The population density of Dehradun is 1900 sq. km. persons per sq. km. In 2001-2011, Dehradun had a growth rate of around 32.48%, which is higher than the national average of 7.64% resulting in congestion in the city core.

3. Ribbon development along major transport corridors: All the primary radial transit routes, particularly Rajpur Road, Chakrata Road, Saharanpur Road, and Haridwar Road in the city are marked with high density unplanned developments. This leads to poor utilization of the right-of-way, increased travel times, increased air pollution, and reduction in the efficiency of the urban economy

4. Inefficient Transport & Parking: 48.1 % of roads in Dehradun are change by on-street parking on both the sides. Weak public transport system has led to plying of Vikrams without permits adding to the level of pollution in the city. There is significant amount of mismanagement in terms of the route planning for the vikrams and city buses

5. Lack of employment opportunities: Low workforce participation, in 2011, the workforce participation ratio was about 34:66. The share of main workers is 30% in the total workforce, 4% is shared by the marginal workers, and share of non- workers are 66%. Absence of enough employment opportunities in the service sector in line with the employable population of the city

6. Dilapidated Heritage structures: The city boasts of heritage structures of colonial times, which are all in very bad shape due to lack of attention towards preserving them and unplanned growth in the city center

7. Depleting green cover with negative impact on the weather of the city: The city located in the foothills of Himalayas, has been traditionally known for its green cover, and excellent weather conditions. The unplanned growth has negatively impacted the green cover of the city and thus the weather

Practical-8

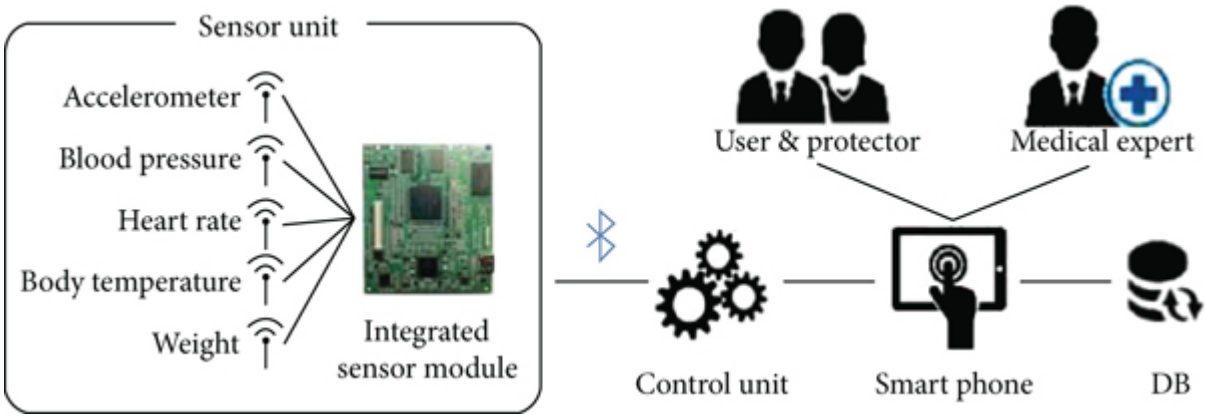
Aim: : **Case study - Health care monitoring**

Introduction

Advances in information and communication technology led to Internet-connected devices such as smartphones, home appliances, wearable devices, and the IoT (Internet of Things) . It is a network environment for analyzing data collected by these devices on a platform, processing them into meaningful data, and creating various services. The IoT consists of four layers: application service, platform, network, and device . In particular, the IoT platform serves as a formalizing interface for processing data generated and collected from devices and providing it to application services. However, in this structure, IoT application services have no choice but to rely on the availability of the IoT platform. In other words, the IoT platform is a factor that causes a single point of failure . Therefore, to solve the issues of such a centralized platform, a lot of research has been conducted on the structure of the distributed IoT. The devices also collect sensitive data associated with the users. Therefore, the privacy issue arises in the IoT, and research is being conducted to solve it. In this paper, we consider how to apply blockchain to IoT to solve the two problems mentioned above . To this end, it derives requirements for constructing a distributed IoT and suggests a direction to be studied in the future to build a blockchain-based IoT platform that satisfies the derived requirements. Based on smart health, we plan to implement a monitoring system that predicts users' current state by detecting movements such as falls by acceleration sensors and measuring health conditions with an individual's vital signs such as blood pressure, heart rate, and body temperature . The goal is to measure biosignals through sensor units, transmit them to the control unit via Bluetooth, store them in the database, analyze the stored biosignals, and derive the user's current state. Therefore, personal medical information is top secret. However, the existing system has poor reliability and security. The method proposed in this paper reinforces reliability and security by incorporating blockchain technology.

System Configuration and Implementation

The smart healthcare monitoring system we want to implement in this paper consists of a sensor unit that can sense the user's condition, a control unit that can control it, and a monitoring system that can be checked on smartphones. Figure shows the proposed system scheme

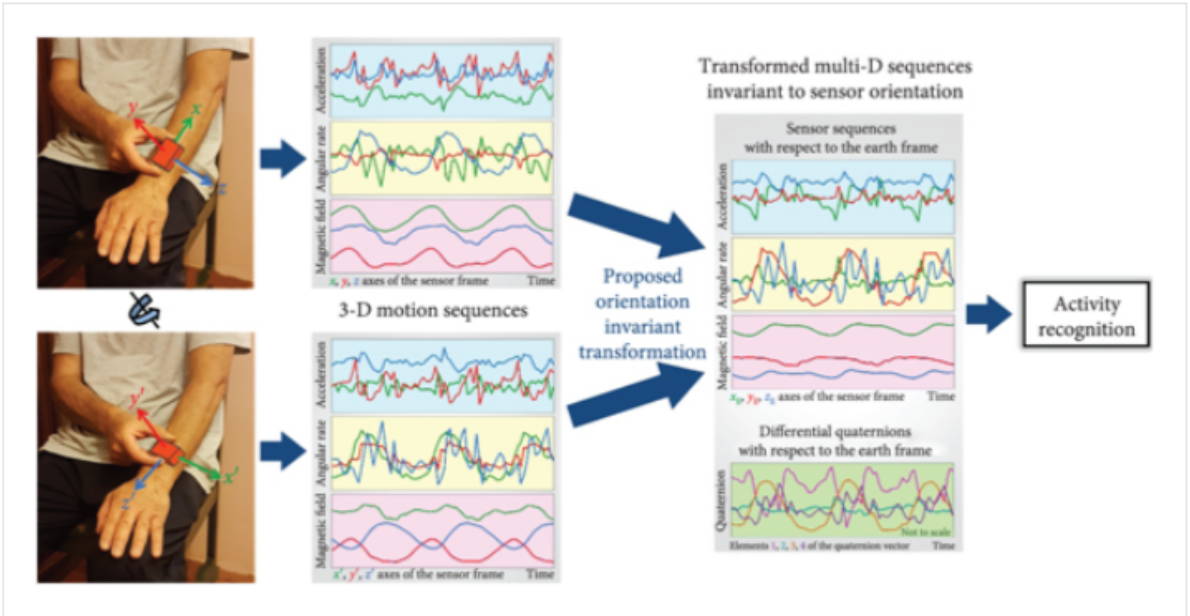


Structure diagram of the system.

In Figure the integrated sensor module collects sensor chip information and stores it in the database through the control device. The stored data provides information to the user in real time through the smartphone.

Sensor Unit

For the smart healthcare monitoring system, we built and used a sensor module that incorporates each measurement sensor to acquire stream data (systolic blood pressure, diastolic blood pressure, heart rate, and body temperature) [25]. Figure 6 shows the sensor unit.

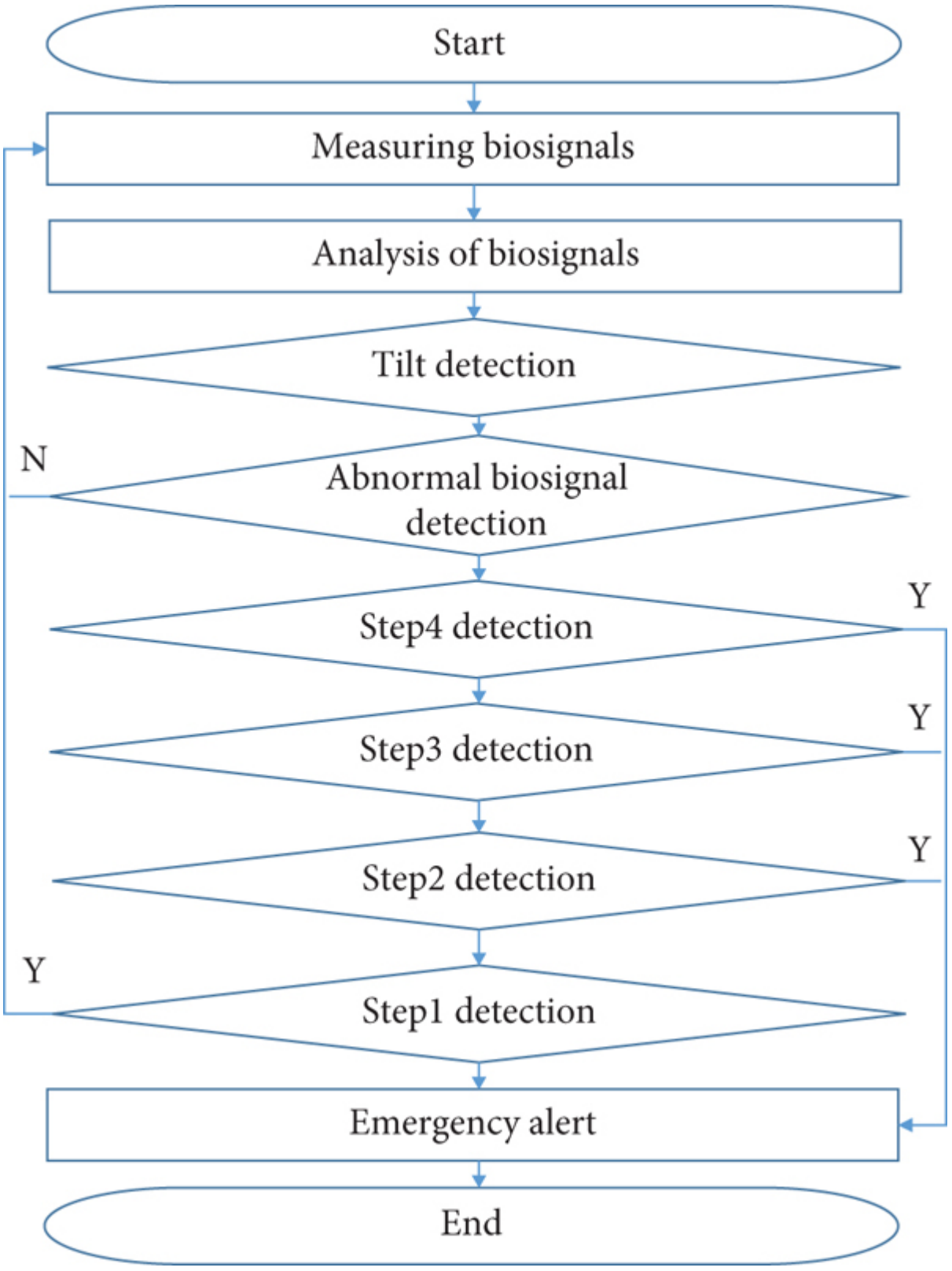


Sensor unit.

The sensor unit was attached to the wrist to measure the biosignals, and the biosignals were measured with reference**.**

Algorithm

The algorithm of smart healthcare monitoring systems implemented is shown below

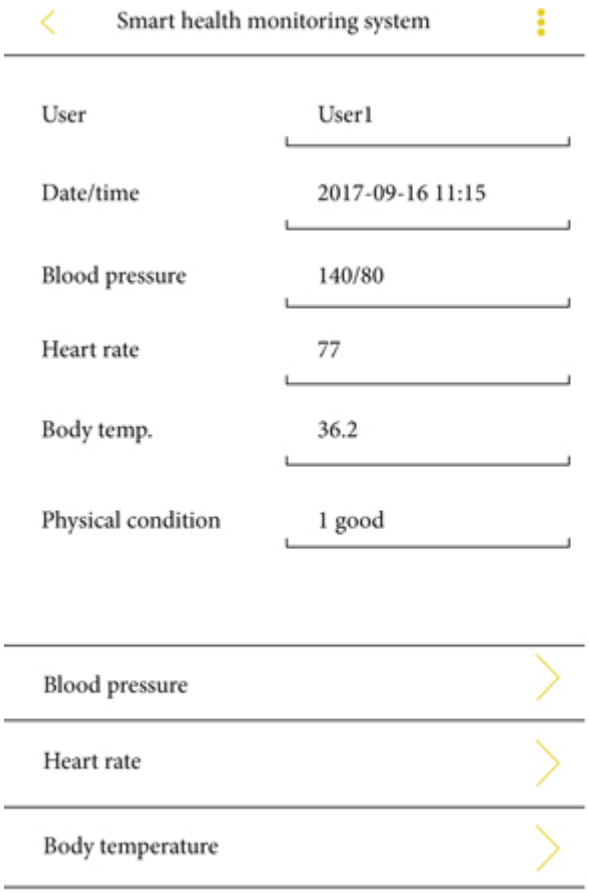


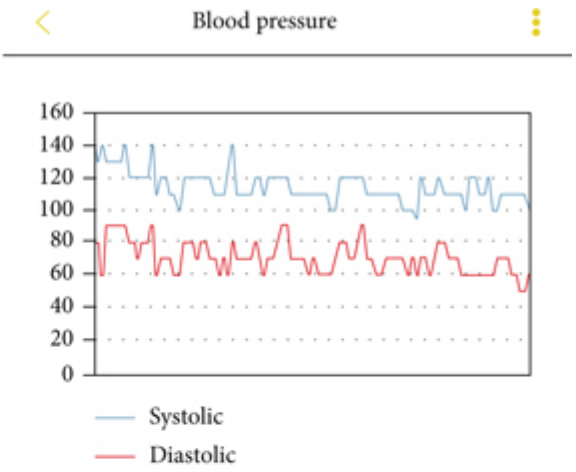
Flow chart of the monitoring system.

The proposed algorithm detects abnormal movements such as falls with the sensor values received from the acceleration sensor and analyzes the biosignals after abnormal movements are detected to determine the user's current state according to the user's biological condition as in Table 2. If a three-stage or higher serious condition is detected, an alarm is sent to the user, requesting a response, and alarms and the current condition are also sent to the guardian and medical staff.

Monitoring System

A monitoring system that allows users, guardians, and experts to check the user's measured biometric information anytime and anywhere using a smartphone was implemented using a JAVA-based Android service environment





Date	Time	Blood pressure	
		Systolic	Diastolic
20170916	11:15	140	80
20170915	15:10	130	80
20170914	11:20	140	60
20170913	11:00	130	90
20170912	11:15	130	90
20170911	11:15	130	90
20170910	15:10	130	90
20170909	10:35	140	90
20170908	10:15	120	80
20170907	10:55	120	80
20170906	10:35	120	70
20170905	16:00	120	80
20170904	9:50	120	80

Result interface of system implementation based on a smartphone.

In the interface, the current condition of users can be identified by classification of the result of the data, items for monitoring numerical data by an hour and date, and biological signal conditions. In addition, a graph item to view the change of each biosignal was added.

Conclusion

As the recent population is expected to experience an extremely aging society, the demand for smart medical devices and telemedicine services for constant disease management is increasing, and the importance and necessity of the smart healthcare industry is inevitable to form an active welfare society. Interest in mobile health is also growing in Korea. In this paper, we proposed a smart health-based monitoring system that detects abnormal movements such as falls with sensor values received from acceleration sensors and analyzes basic biosignals of an individual's blood pressure, heart rate, and body temperature after detecting abnormal movements. A monitoring system was implemented using a JAVA-based Android service environment so that users, guardians, and experts can check the user's measured biometric information anytime and anywhere using a smartphone, and the performance evaluation was conducted with biological signals such as 500 systolic blood pressure, diastolic blood pressure, heart rate, and body temperature datasets of 50 individuals. As a result of the experiment, the SVM algorithm for analyzing biosignals showed an average error rate of 2%. When the window size was divided by 5000, it was shown to be effective by reducing the maximum by 19.2% of the storage space. The classification accuracy was the highest at 97.2% when the window size was divided by 5000. Of the total 5000 evaluation data, 84 results came out differently, but there were no significant problems; i.e., the results from the system were lower than the expert's judgment with approximately 98% accuracy. In the future, we believe that a more improved system will be achieved with the addition of ultrasmall biometric sensors and patient positioning functions, the implementation of a home network system using wireless sensors, and a study on the development of an algorithm that can predict fall accidents before they happen. This paper has applied blockchain technology to improve reliability and maintain confidentiality to protect personal medical information. The accumulation of personal medical information is stored in data and monitored in real time using a sensor chip, an Internet of Things technology. Personal medical information is provided through a smartphone in real time.

Practical 9
Exploring Tinkercad software.

INTRODUCTION:

What is Tinkercad?

- TinkerCAD is a free online service for creating basic 3D shapes and developing digital prototypes of electronic components. These prototypes include basic circuits with LED lights, buzzers, switches, and even light sensors.
- Conventional CAD software options are not only expensive, but they're also often quite complicated to learn. These programs often have many features, that you won't even use for something as simple as a custom case. While they are great for professional users, makers will more likely be happy with Tinkercad, which I regularly use. It's not only free but also very easy to learn and to use.

How to Create a Tinkercad Account

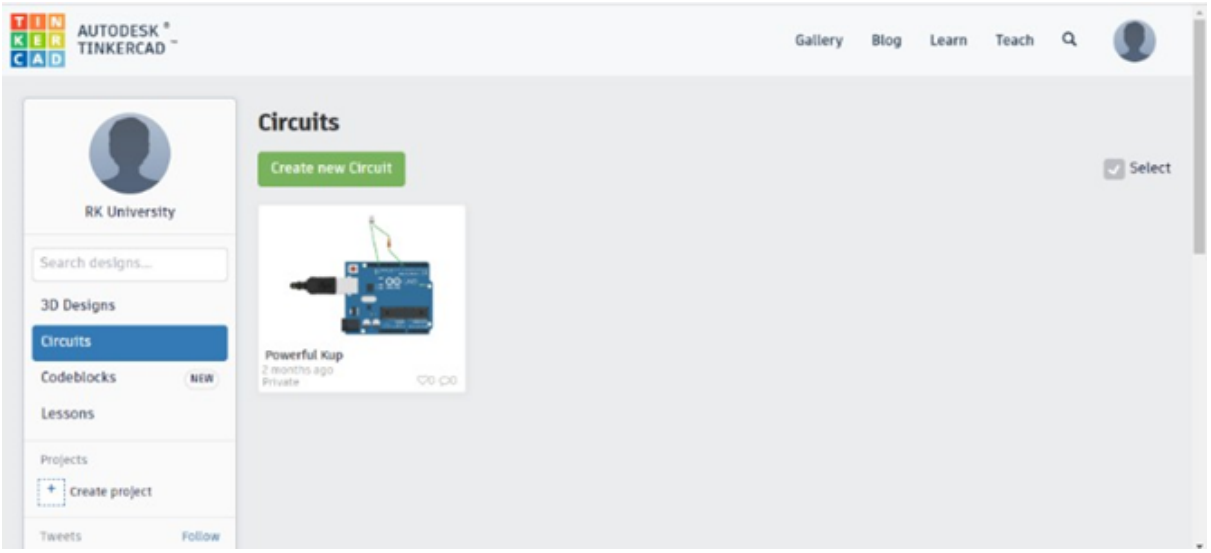
1. Click Sign Up on the Tinkercad homepage.
2. Choose your country from the drop-down list.
3. Enter your birthday.
4. Click the Next button.
5. Add your email address and a password, accept the Tinkercad terms of service, and click Create Account.
6. If you want to receive email communication from Autodesk, select the permissions box and then click Done.

A confirmation email is sent to the email you provided. And that's it! You now have a Tinkercad account. Also, upon signing up you are automatically logged in to Tinkercad, too.

Getting Started

- Before you start designing your case in Tinkercad, make sure to get a rough idea of what you want your case to look like by creating a hand-drawn sketch.
- After you have a drawing you are satisfied with, visit Tinkercad's website. You'll need to create a free account to access the service. After logging in, you'll be greeted with a screen similar to this one:

• Click on “Create new design” right below “My recent designs” next to your profile picture. A new design will open up.

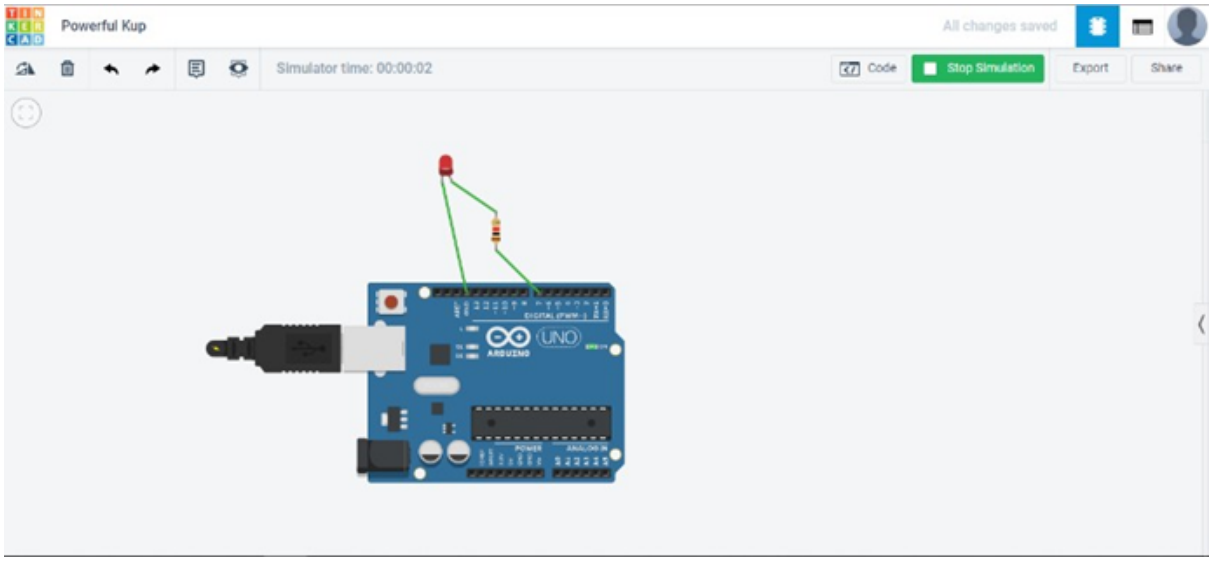


PROGRAMS :

(A) Write a program to blink and led in Tinkercad. Code :

```
int counter; void setup()
{
pinMode(7, OUTPUT);
}
void loop()
{
for (counter = 0; counter < 10; ++counter) { digitalWrite(7, LOW);
delay(2000); // Wait for 2000 millisecond(s) digitalWrite(7, HIGH);
delay(2000); // Wait for 2000 millisecond(s)
} }
```

OUPUT:

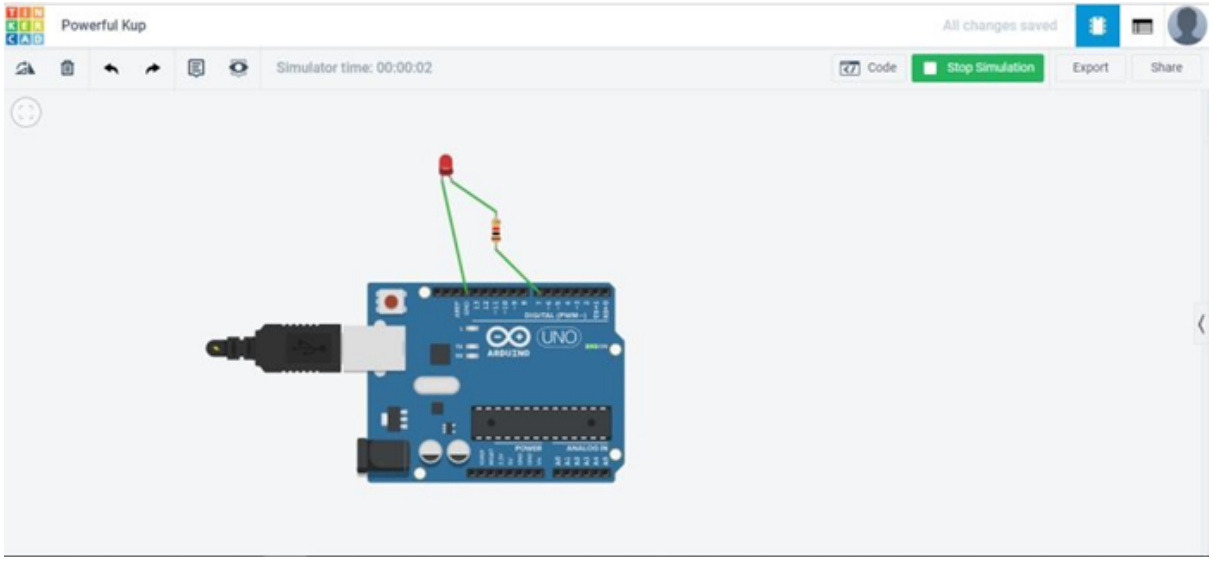


(B) Write a program to control brightness of the led in Tinkercad.

Code :

```
int brightness = 0; void setup(){
pinMode(7, OUTPUT);
}
void loop(){
for (brightness = 0; brightness <= 255; brightness += 5) { analogWrite(7, brightness);
delay(30); // Wait for 30 millisecond(s)
}
for (brightness = 255; brightness >= 0; brightness -= 5) { analogWrite(7, brightness);
delay(30); // Wait for 30 millisecond(s)
} }
```

OUTPUT:

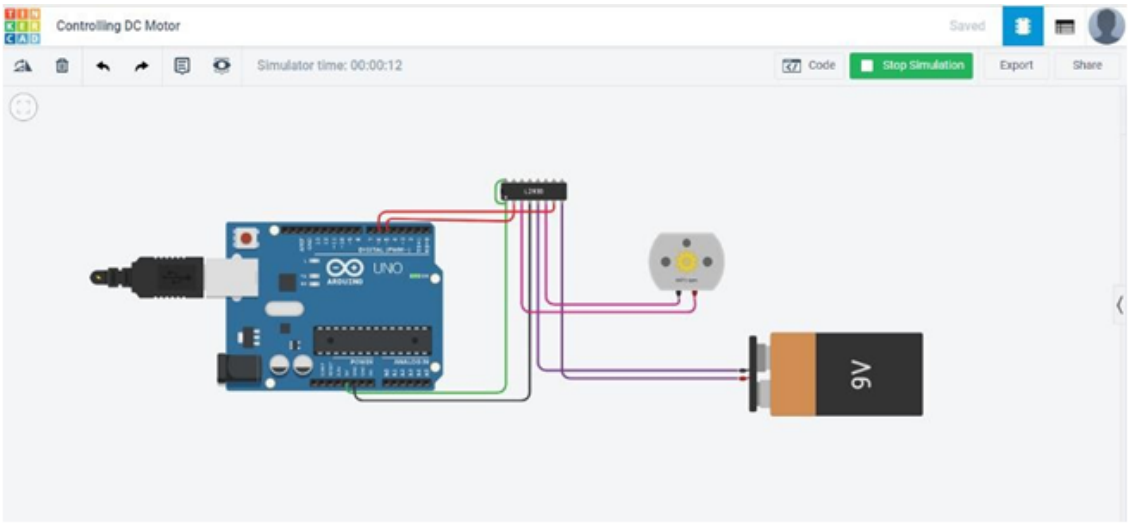


(C) Write a program to run motor in Tinkercad.

Code :

```
void setup(){ pinMode(6, OUTPUT);
pinMode(5, OUTPUT);
}
void loop(){ analogWrite(5,100);
delay(2000); // Wait for 1000 millisecond(s) analogWrite(6,0);
delay(1000); // Wait for 1000 millisecond(s) analogWrite(5,500);
delay(2000); // Wait for 1000 millisecond(s) analogWrite(6,0);
delay(1000); // Wait for 1000 millisecond(s)
 }
```

OUTPUT:



Practical 10
Exploring Thingspeak software.

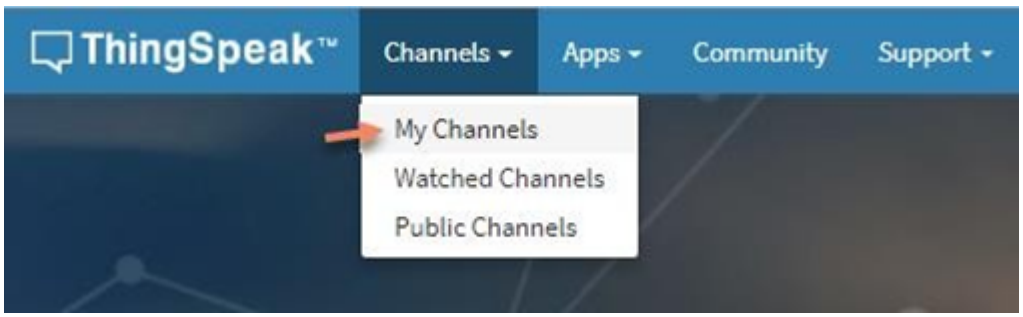
INTRODUCTION:

What is ThingSpeak ?

ThingSpeak is a platform providing various services exclusively targeted for building IoT applications. It offers the capabilities of real-time data collection, visualizing the collected data in the form of charts, ability to create plugins and apps for collaborating with web services, social network and other APIs.

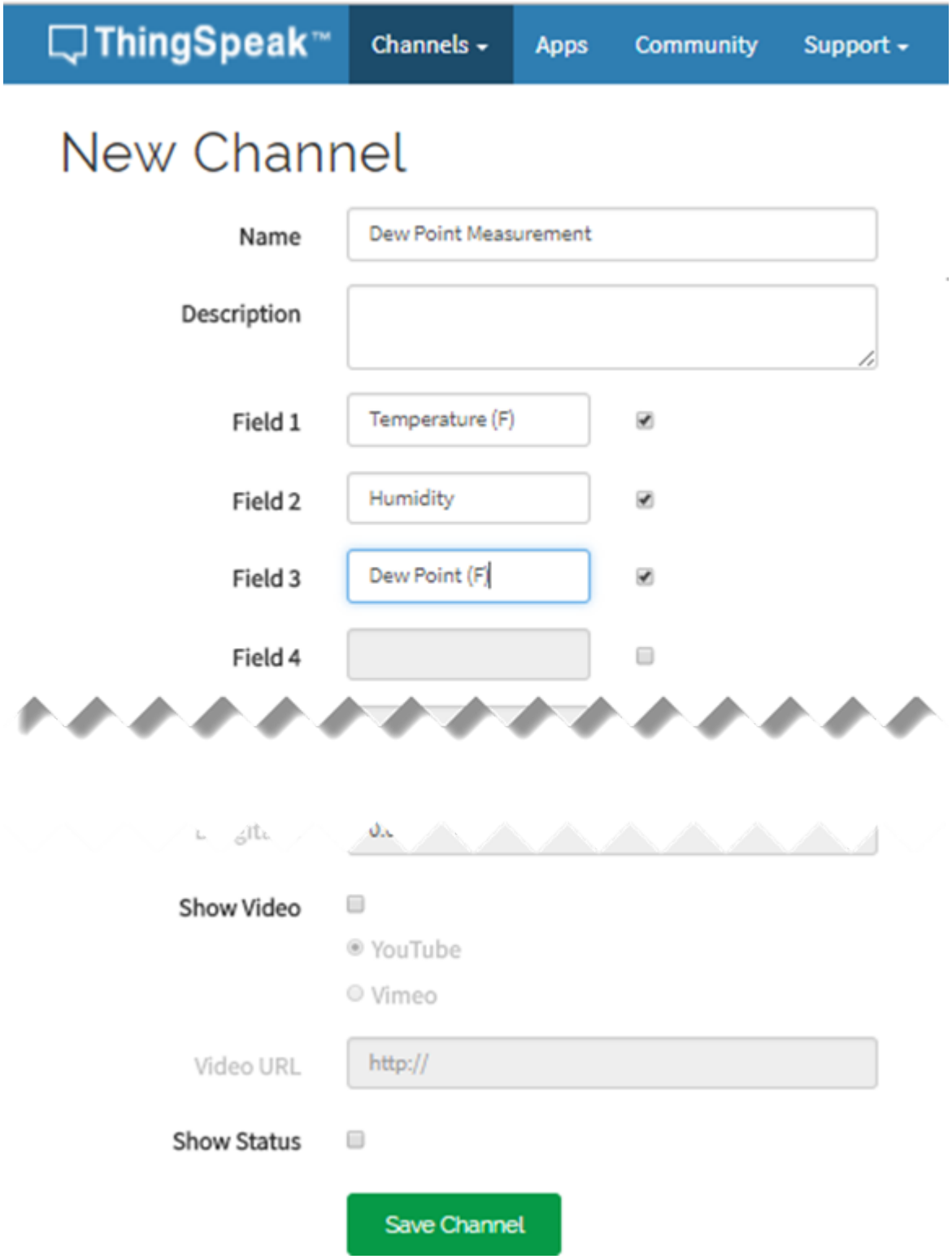
Create a Channel

1. Sign In to ThingSpeak™ using your MathWorks® Account, or create a new MathWorks account.
2. Click Channels > MyCha



3. On the Channels page, click New Channel.
4. Check the boxes next to Fields 1–3. Enter these channel setting values:

- Name: RK University
- Field 1: Temperature (F)
- Field 2: Humidity
- Field 3: RKU Point



5. Click Save Channel at the bottom of the settings. You now see these tabs:

- Private View: This tab displays information about your channel that only you can see.
- Public View: If you choose to make your channel publicly available, use this tab to display selected fields and channel visualizations.

- Channel Settings: This tab shows all the channel options you set at creation. You can edit, clear, or delete the channel from this tab.
- Sharing: This tab shows channel sharing options. You can set a channel as private, shared with everyone (public), or shared with specific users.
- API Keys: This tab displays your channel API keys. Use the keys to read from and write to your channel.
- Data Import/Export: This tab enables you to import and export channel data.

Next Steps
Your channel is available for future use by clicking Channels > My Channels.

PROGRAMS :

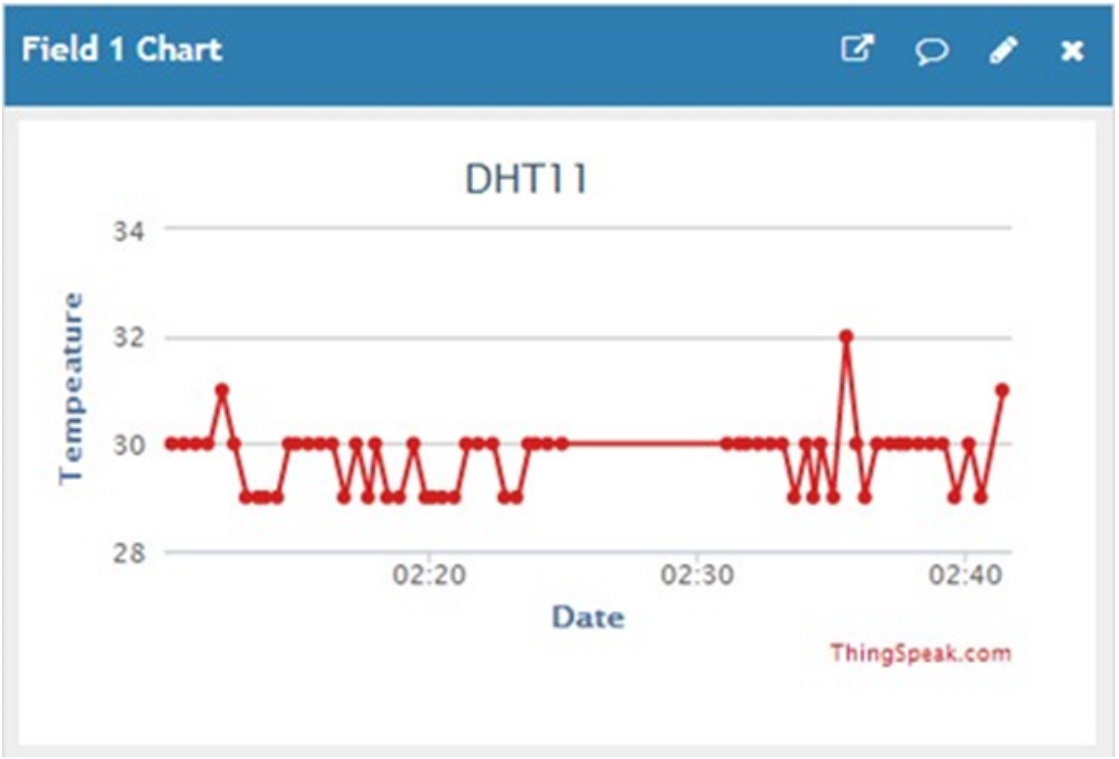
(A) Interfacing of NodeMCU with DHT11 sensor and getting data on ThingSpeak.

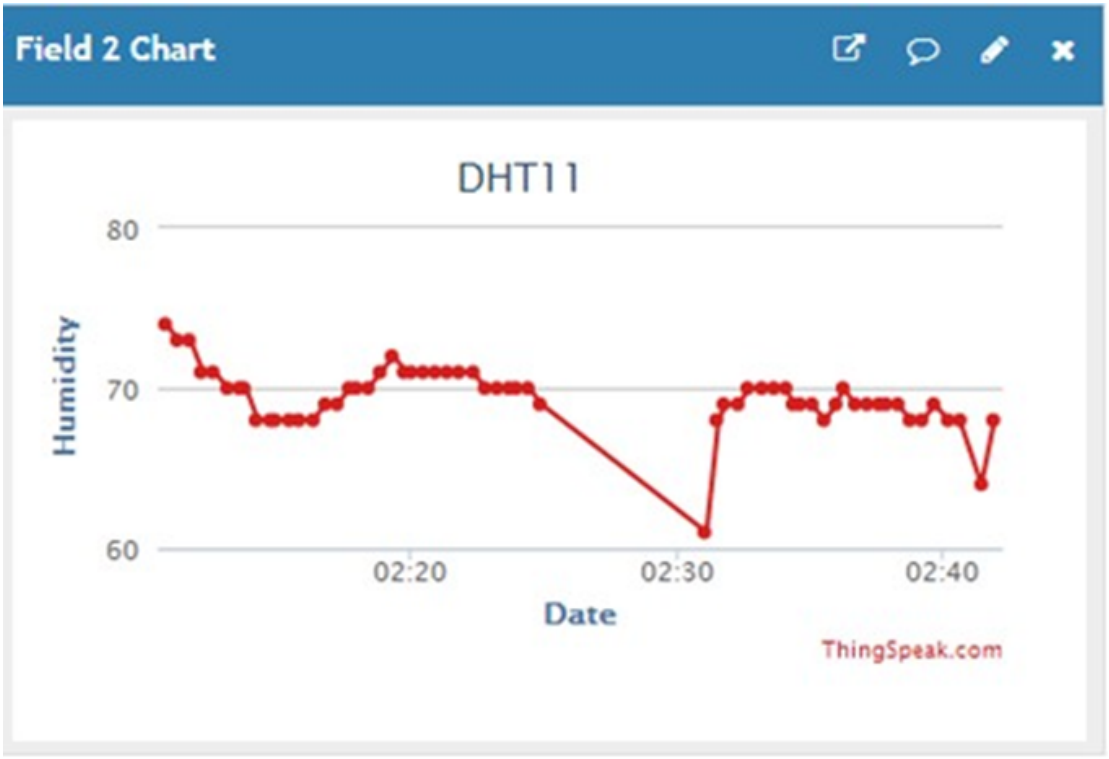
Code :

```
#include <DHT.h> // Including library for dht #include <ESP8266WiFi.h>

String apiKey = "Your API of thingsspeak"; const char *ssid = "Your wifi Network name";
const char *pass = "Network password";
const char* server = "api.thingspeak.com";

#define DHTPIN 0//pin where the dht11 is connected DHT dht(DHTPIN, DHT11);
WiFiClient client; void setup() {
Serial.begin(115200); delay(10); dht.begin();
Serial.println("Connecting to "); Serial.println(ssid); WiFi.begin(ssid, pass);
while (WiFi.status() != WL_CONNECTED){ delay(500);
Serial.print(".");
}
Serial.println(""); Serial.println("WiFi connected");
}
void loop(){
float h = dht.readHumidity(); float t = dht.readTemperature();
if (isnan(h) || isnan(t)) {
Serial.println("Failed to read from DHT sensor!"); return;
}
if (client.connect(server,80)){ String postStr = apiKey; postStr +="&field1="; postStr +=
String(t); postStr +="&field2=";
 postStr += String(h); postStr += "\r\n\r\n";
client.print("POST /update HTTP/1.1\n");
 client.print("Host: api.thingspeak.com\n"); client.print("Connection: close\n");
urlencoded\n");
```

```
}

client.print("X-THINGSPEAKAPIKEY: "+apiKey+"\n");
client.print("Content-Type: application/x-www-form-

client.print("Content-Length: "); client.print(postStr.length()); client.print("\n\n");
client.print(postStr);

Serial.print("Temperature: "); Serial.print(t);
Serial.print(" degrees Celcius, Humidity: "); Serial.print(h);
Serial.println("%. Send to Thingspeak.");

client.stop(); Serial.println("Waiting...");
delay(10000);
}
```

Output :






```
{l d□| □l□|    □ □$□ c|□□ □ □r□b□ b□□on□lon□□□ " p□#$` rdp□o□    □ l □□   c n□|
RoboIndiaOFC
.............
WiFi connected
Temperature: 31.00 degrees Celcius, Humidity: 64.00%. Send to Thingspeak.
Waiting...
Temperature: 30.00 degrees Celcius, Humidity: 67.00%. Send to Thingspeak.
Waiting...
Temperature: 30.00 degrees Celcius, Humidity: 68.00%. Send to Thingspeak.
Waiting...
Temperature: 30.00 degrees Celcius, Humidity: 68.00%. Send to Thingspeak.
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Waiting...
```