Chapter 1

INTRODUCTION

Introduction

Any production or trading has a need to store their reserves or any useful stuff somewhere. This function is performed by warehouses or storages in most cases. The warehouse can be an open platform, which is used for material storage or it can also be complex modern construction, where the goods are kept, which requires observance of certain conditions. With an increase in the number of warehouses, cold storage units and factories, the need for monitoring various attributes in such factories has become a thing of great necessity. Automation has become an inseparable part of today's world for which IoT has emerged as an excellent platform providing connectivity between various sensors, controllers and internet that enables remote monitoring and controlling of different environments subject to automation. With advances in technology, the various sensors to measure different parameters such as temperature, gases, humidity etc. have become more viable and affordable. Upcoming IoT architectures and sensor networks allow real-time remote monitoring and analysis of a system as well as the possibility to take immediate remedial actions if necessary. Temperature Monitoring of Data Centers, Server Rooms, UPS Room, Battery Rooms and similar critical installations are extremely important to maintain the efficient working of all equipment inside the room. The performance of the equipment is drastically affected by an increase in Temperature and Humidity and hence need reliable systems. We provide various solutions for such monitoring purposes with Feedback, alerts, and Location check.

If we look at the warehouse landscape and the way client expectations are shaping, is the expectation to get very good visibility of inventory and to be able to change things fast. It is about retrieving data from all the sensors and transforming it into business valuable information. Stock visibility or the ability to know where each item is, where it came from, was the main demand from the supply chain and warehouse managers. Our supply chain platform provides global visibility to track inventory result that came from which warehouse. It is important for efficiency, as well as for redundancy and contingency planning.

A various warehouse used for storing medicine, food, vegetables etc. have temperature and humidity-controlled environments. Real-time monitoring solutions will continuously monitor temperature and humidity of the area. The device will continuously record the data on itself and display on LCD display as well as over the cloud and android application. The controlling and monitoring system will work automatically and will also generate alerts for alert conditions. The system will generate alerts if temperature or humidity goes above or below the programmed limits. Recording happens on the device and on a cloud platform. Graphs and charts display will be available on the cloud or on mobile. The system can send daily or weekly data summary report. Each sensor can have different alert levels as per requirement.

Motivation

Automation has become an inseparable part of today’s world for which IoT has emerged as an excellent platform providing connectivity between various sensors, controllers and internet that enables remote monitoring and controlling of different environments subject to automation. Storage is an important aspect of the total logistic business as it directly affects the product quality and thus the total revenue.

In this paper, we propose a Warehouse Management System based on Wi-Fi which enables the user to monitor and control the storage conditions all the time globally through the cloud and mobile android application access. The previous system used in a warehouse where data logger which do not provide the controlling of the sensor. The worker has to control manually but due to the expectation of flexible and agile in operation. This system will provide a control interface through the mobile android application so, that continuous viewing is possible on smartphone, tablets and computer. If there are different warehouse then it is difficult to predict the data. To avoid this system uses a global positioning system to track the location of a particular warehouse and then control the data. As the storage is huge it is difficult to provide wiring to each sensor node, therefore, the implementation of wireless sensor is preferred.

As shown in the block diagram (fig.1) propose designing ARM-based processor and interfacing of on-board modules such as Bluetooth, GSM and GPS module. Bluetooth module is used for communication medium between sensor and processor. Collecting sensor data of warehouse such as temperature, humidity or gases and then the data will be transferred to the network. The processor will act as a gateway by using its feature and specification designing of low power and high-efficiency system can be implemented. By using 2G/3G wireless connectivity i.e. GSM modem which accepts a SIM card and operates over a subscription to a mobile operator will provide connection to the cloud. In cloud computing designing of Algorithm for the database, Analytics, checkpoint and measurement of sensor data is viewed.

For control and monitor interface we will create a mobile application using Android APK. As per global positioning system (GPS) interface which will obtain position information of warehouse so that client can monitor storage information. GPS receiver detects ranging signal from several satellites to locate itself GPS receiver must find the distance of three satellite of known position. To obtain range delta it measures the difference between times of arrival to transmission and is multiplied by the speed of light. This will provide a location check of different warehouses on APK. The device will monitor results and graphs of sensor data and it will generate alert and feedback according to programmed on APK.

Brief Literature Review

Since Rao Aamir KhushNaseeb and Nuzhat Younis [2] study have proposed the basics of warehouse management system starting from type and nature of warehouses along with the study of which type of warehouse management system are available to supporting manufacturing process proactively.

SerbulentTozlu, Murat Senel, and Wei Mao [3] had proposed a practical approach for the feasibility of low-power Wi-Fi to enable IP connectivity of battery-powered devices with three key practice areas of concern: Power consumption, the impact of interference, and communication range. At high data rates, transmitting/receiving data and packet size have a small impact on power consumption. On the other hand, at low data rates, the impact of transmitting/receive energy and packet size becomes noticeable.

Prof. Dr Dipashree Bhalerao [1] had proposed a Warehouse Management System based on light-weight MQTT protocol which enables the user to monitor and control the storage conditions of fruits/vegetables all the time globally through the web page access. Further, this system also provides quantitative fruits/vegetable freshness updates and on qualitative measures, it gives fruits/vegetable rotting alerts. IoT is furnished with a number of application layer protocols, thus this paper includes an overview and comparative results of two potential M2M communication protocols, MQTT and COAP, in terms of bandwidth consumption and network latency.

Youngjae Lee and Jinhong Kim [5] had proposed a system that can be extended to the smart warehouse by connecting more sensors to a DCU to get much information and by using the database-based IoT platform. To set up such a system, many sensors are installed to give the information to the central servers. To send the sensor data at the constant interval, it is necessary to use a DCU that is collecting data and sending in row.

Nikesh Gondchawar [6] had proposed smart warehouse management which includes; temperature maintenance, humidity maintenance and theft detection in the warehouse. Controlling of all these operations performed through any remote smart device or computer connected to Internet yet they did not give any automated database updates so this paper introduces the Warehouse Automation System which helps the owner of the warehouse to monitor the warehouse storage conditions from all around the world and henceforth to take any controlling actions if required.

Chandanashree V C [4] work provides an overview of the development of an IoT based cold storage warehouse monitoring system a complete system consisting of the sensors for a Cold Storage Monitoring System was successfully designed, developed and implemented. This system able to visualize and analyze sensor data in a real-time environment using Zeppelin. The system was successfully able to monitor the health of a cold storage warehouse.

Problem Statement:

"IoT Sensor Based Warehouse Monitoring System and Control Interface Implementation".

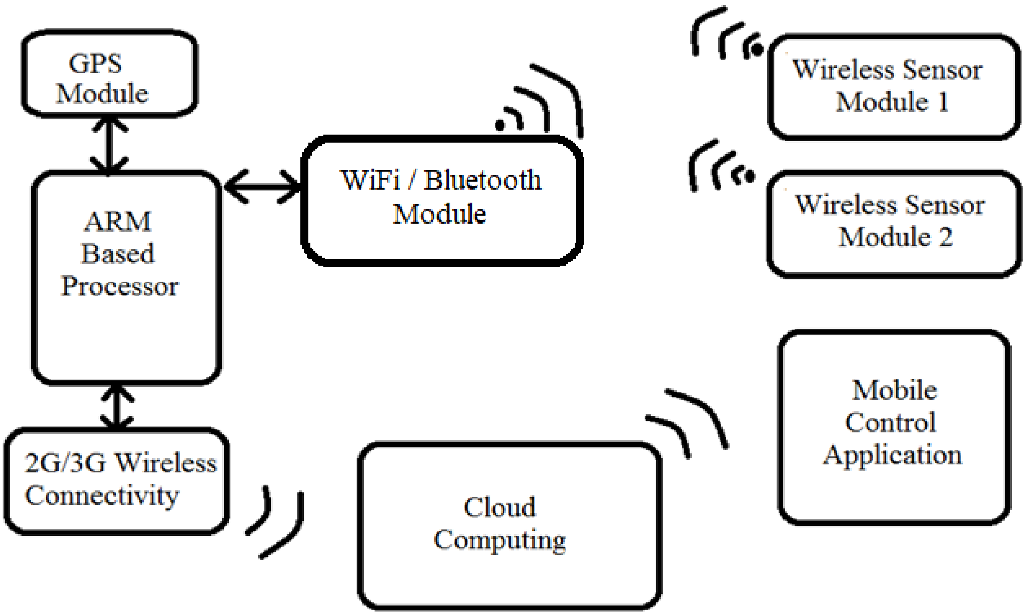
Objectives:

- Design of a circuit with PCB layout and assembly of the development board for IoT based system.
- Board verification, Processor program development and Writing Device Drivers for the System.
- Study and development of Application Studio for APK-UI development and APK-cloud Interface.
- Cloud-based data Analytics Algorithm implementation and result monitor mechanism in APK.
- Experiment on Test setup for Hardware/Software and Validation of result.

Chapter 2

Block Diagram of the System

Block diagram of overall system

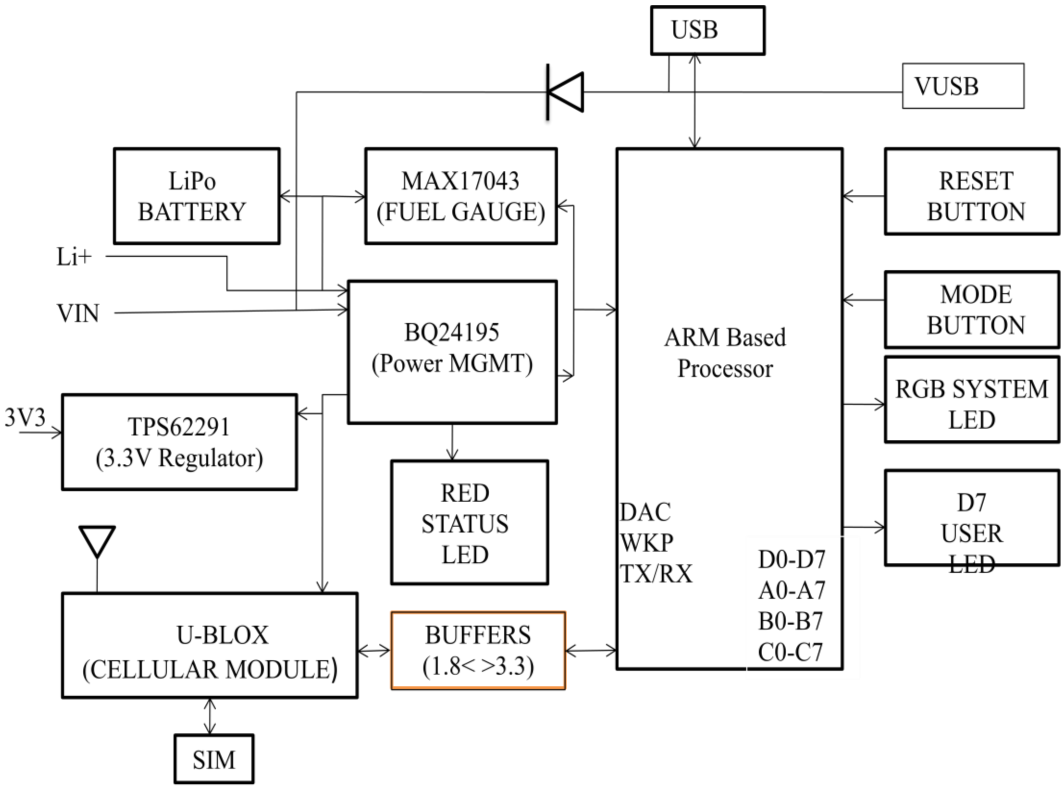


Arm based processor i.e STM32F205RGY which is used for gateway. It is interfaced by wireless module lie Bluetooth or Wi-Fi for connectivity with sensors. In real time monitoring solution requires continuously monitor temperature, humidity, and Gas in warehouse. Sensor will send data using wireless module to ARM processor. We have interface GPS to track the location of warehouse. It transfers the data in NMEA format to processor. The GPS frame and sensor Data is updated on cloud. We can Control and set limit of temperature and view maximum temperature value on mobile application. The GUI shows temperature, humidity value, maximum temperature and set point. We have interface gas sensor to detect smoke in warehouse if it goes above set point it will show gas detected on mobile application we can download the reading of sensor data in excel .

Chapter 3

Block Diagram and Circuit Diagram of the Board

Block diagram of development board



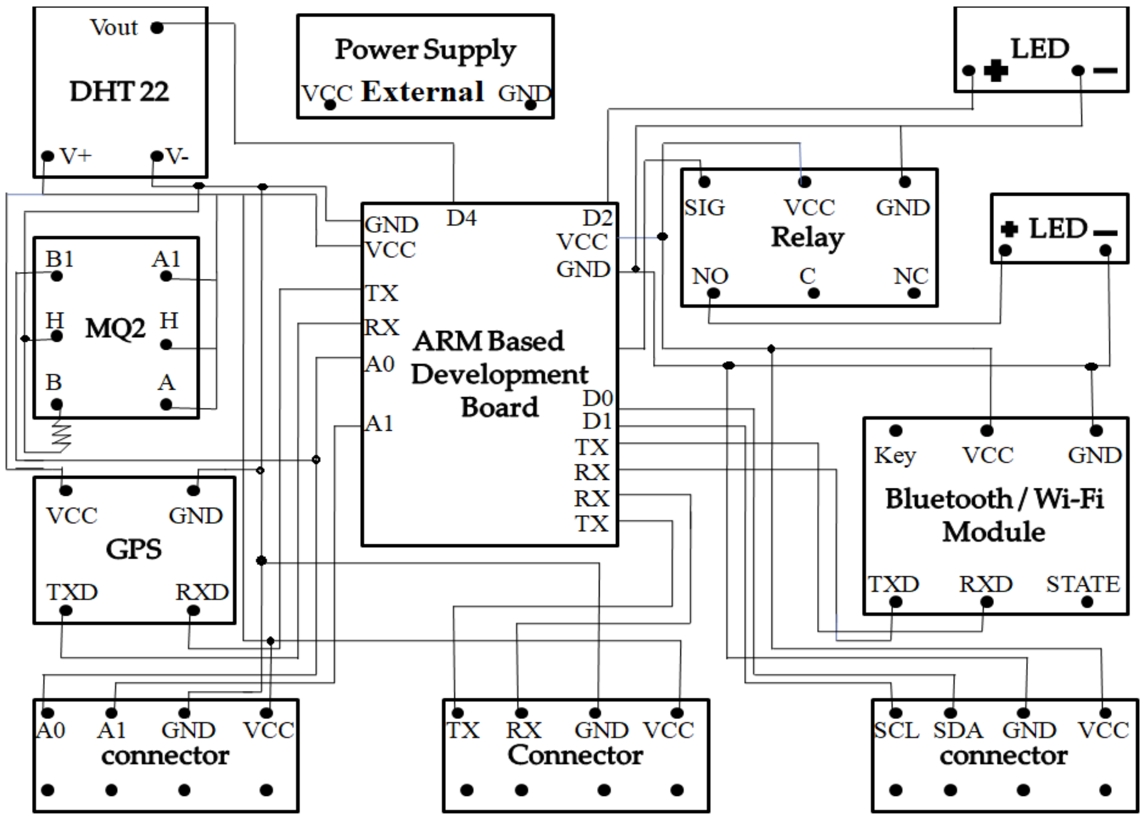
POWER:

The Electron can be powered via the VIN (3.9V-12VDC) pin, the USB Micro B connector or a LiPo battery.

USB

Most USB ports can supply only a maximum of 500mA, but the u-Blox GSM module on the Electron alone can consume a peak of 800mA to 1800mA of current during transmission. In order to compensate of this deficit, one must connect the LiPo battery at all times when powering from a traditional USB port. The Electron will intelligently source power from the USB most of the time and keep the battery charged. During peak current requirements, the additional power will be sourced from the battery. This reduces the charge-discharge cycle load on the battery, thus improving its longevity.

Circuit Diagram



VIN

The input voltage range on VIN pin is 3.9VDC to 12VDC. When powering from the VIN pin alone, make sure that the power supply is rated at 10W (for example 5VDC at 2Amp). If the power source is unable to meet this requirement, you'll need connect the LiPo battery as well. An additional bulk capacitance of 470uF to 1000uF should be added to the VIN input when the LiPo Battery is disconnected. The amount of capacitance required will depend on the ability of the power supply to deliver peak currents to the cellular modem.

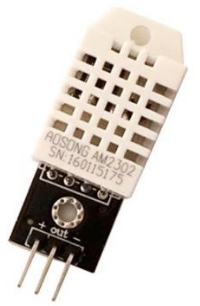
VUSB

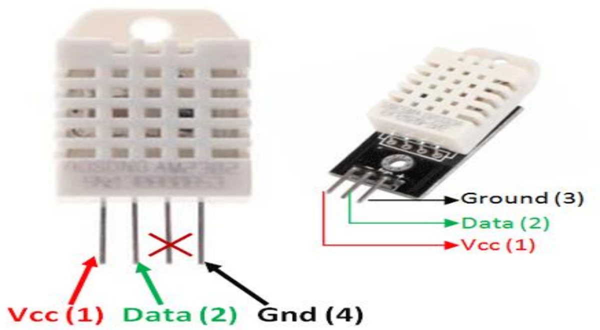
This pin is internally connected to USB supply rail and will output 5V when the Electron is plugged into an USB port. It is intentionally left unpopulated. This pin will *NOT* output any voltage when the Electron is powered via VIN and/or the LiPo battery.

Chapter 4

Sensors

DHT22 – Temperature and Humidity Sensor:





DHT22 temperature sensor module DHT22 sensor pin out

Pin Identification and Configuration:

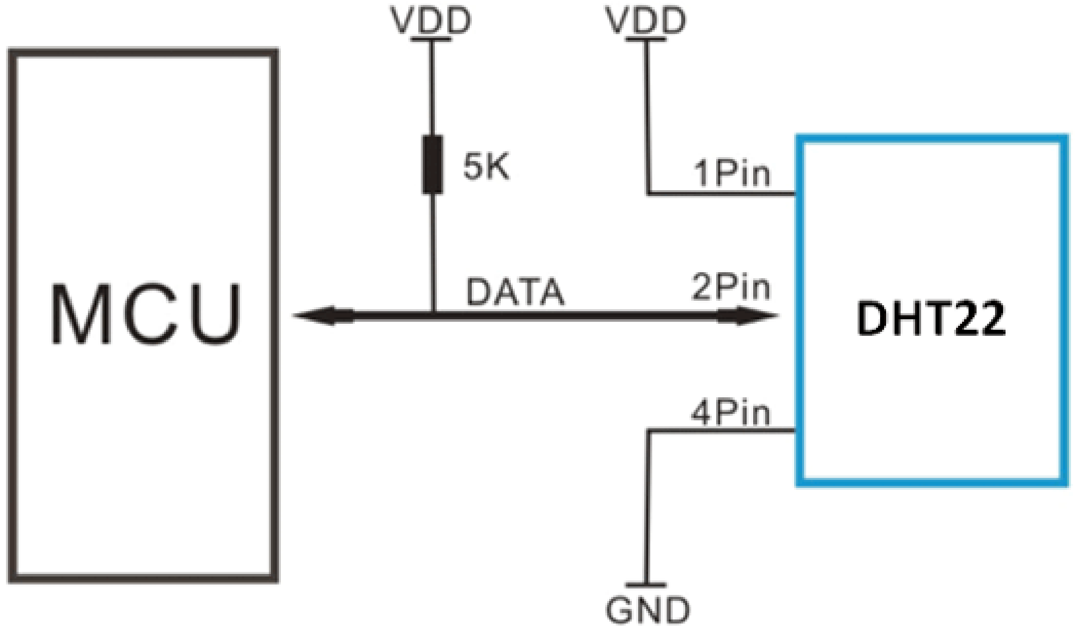
No:	Pin Name	Description
For DHT22 Sensor		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	NC	No Connection and hence not used
4	Ground	Connected to the ground of the circuit
For DHT22 Module		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	Ground	Connected to the ground of the circuit

DHT22 Specifications:

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: -40°C to 80°C
- Humidity Range: 0% to 100%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±0.5°C and ±1%

Difference between DHT22 Sensor and Module:

The DHT22 sensor is the successor of the DHT module. it can either be purchased as a sensor or as a module. Either way the performance of the sensor is same. The sensor will come as a 4-pin package out of which only three pins will be used whereas the module will come with just three pins as shown in the DHT22 pin out above. The only difference between the sensor and module is that the module will have a filtering capacitor and pull-up resistor inbuilt, and for the sensor you have to use them externally if required. The module is slightly costly than the DHT11, but it has a higher measuring range and slightly better accuracy. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

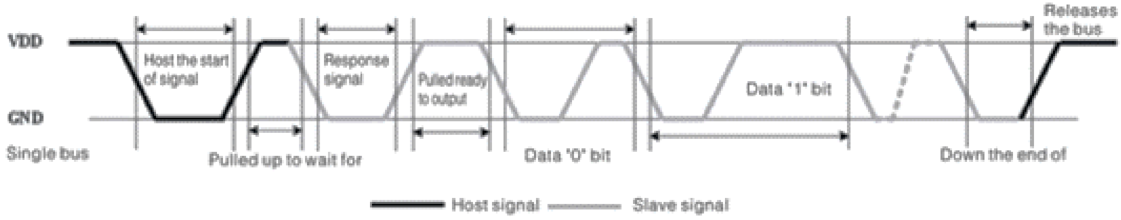


The data pin is connected to an I/O pin of the MCU and a 5K pull up resistor is used. This data pin outputs the value of both temperature and humidity as serial data.

Operating specifications:

Power and Pins Power's voltage should be 3.3-6V DC. When power is supplied to sensor, don't send any instruction to the sensor within one second to pass unstable status. One capacitor valued 100nF can be added between VDD and GND for wave filtering. Communication and signal Single-bus data is used for communication between MCU and DHT22; it costs 5mS for single time communication. Data is comprised of integral and decimal part; the following is the formula for data. DHT22 send out higher data bit firstly! DATA=8-bit integral RH data+8-bit decimal RH data+8-bit integral T data+8-bit decimal T data+8-bit check-sum If the data transmission is right, check-sum should be the last 8 bits of 8-bit integral RH data+8-bit decimal RH data+8-bit integral T data+8-bit decimal T data". When MCU send start signal, DHT22 change from low-power-consumption-mode to running-mode. When MCU finishes sending the start signal, DHT22 will send response signal of 40-bit data that reflect the relative humidity and temperature information to MCU. Without start signal from MCU, DHT22 will not give response signal to MCU. One start signals for one time's response data that reflect the relative humidity and temperature information from DHT22. DHT22 will change to low-power-consumption-mode when data collecting finish if it doesn’t receive start signal from MCU. Long transmission distance (20m) enables DHT22 to be suited in all kinds of harsh application occasions.

Overall communication process:



Technical Specification:

Model	DHT22
Power supply	3.3-6V DC
Output signal	digital signal via single-bus
Sensing element	Polymer capacitor
Operating range	humidity0-100%RH; temperature-40~80Celsius
Accuracy	humidity +-2%RH (Max +-5%RH); temperature <+-0.5Celsius
Resolution or sensitivity	humidity0.1%RH; temperature0.1Celsius
Repeatability	humidity+-1%RH; temperature+-0.2Celsius
Humidity hysteresis	+-0.3%RH
Long-term Stability	+-0.5%RH/year
Sensing period	Average: 2s
Interchangeability	fully interchangeable
Dimensions	smallsize14*18*5.5mm; big size22*28*5mm

Electrical Characteristics:

Item	Condition	Min	Typical	Max	Unit
Power supply	DC	3.3	5	6	V
Current supply	Measuring	1		1.5	mA
	Stand-by	40	Null	50	uA
Collecting period	Second		2		Second

MQ-2 Semiconductor Sensor for Combustible Gas

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, the sensor’s conductivity is higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration.
MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application

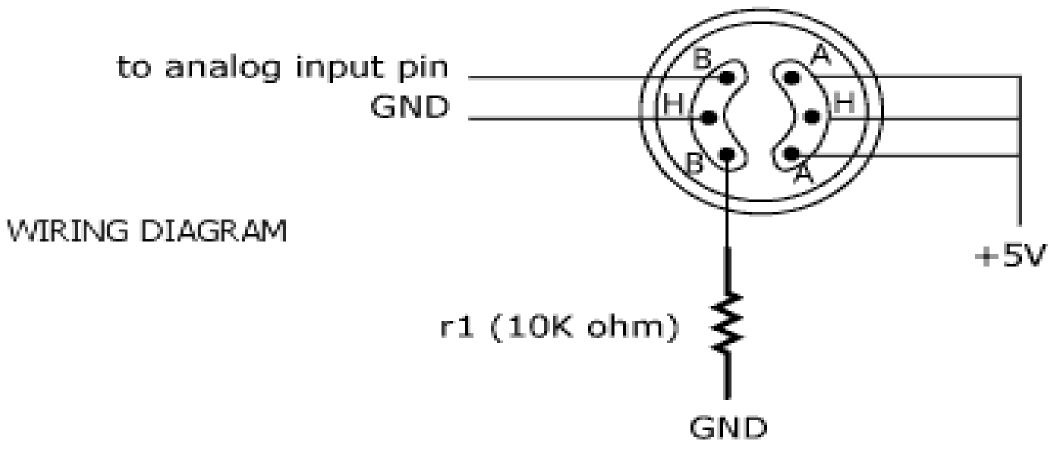
Features

- Good sensitivity to Combustible gas in wide range
- High sensitivity to LPG, Propane and Hydrogen
- Long life and low cost
- Simple drive circuit
- Operating Voltage is +5V
- Can be used to Measure or detect LPG, Alcohol, Propane, Hydrogen, CO and even methane
- Analog output voltage: 0V to 5V
- Digital Output Voltage: 0V or 5V (TTL Logic)
- Preheat duration 20 seconds
- Can be used as a Digital or analog sensor
- The Sensitivity of Digital pin can be varied using the potentiometer

Application

- Domestic gas leakage detector
- Industrial Combustible gas detector
- Portable gas detector

Internal Diagram



Pin Description

Pin No:	Pin Name:	Description
For Module		
1	Vcc	This pin powers the module, typically the operating voltage is +5V
2	Ground	Used to connect the module to system ground
3	Digital Out	You can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer
4	Analog Out	This pin outputs 0-5V analog voltage based on the intensity of the gas
For Sensor		
1	H -Pins	Out of the two H pins, one pin is connected to supply and the other to ground
2	A-Pins	The A pins and B pins are interchangeable. These pins will be tied to the Supply voltage.
3	B-Pins	The A pins and B pins are interchangeable. One pin will act as output while the other will be pulled to ground.

Chapter 5

Cloud, GPS, GSM and Android Application

We use of cloud service without our notice like web-based email service, watching movies through the internet, editing documents, storing pictures etc uses cloud computing on the back-end.

Cloud Platforms:

15 Top Cloud Computing Service Provider Companies are:

- Amazon Web Services
- Microsoft Azure
- Google Cloud Platform
- Adobe
- VMware
- IBM Cloud
- Rackspace
- Red Hat
- Salesforce
- Oracle Cloud
- SAP
- Verizon Cloud
- Navisite
- Dropbox
- Egnyte

Cloud computing services are categorized into three types:

Infrastructure as a Service (IaaS): This service provides the infrastructure like Servers, Operating Systems, Virtual Machines, Networks, and Storage etc on rent basis.

E.g.: Amazon Web Service, Microsoft Azure.

Platform as a Service (PaaS): This service is used in developing, testing and maintaining of software. PaaS is same as IaaS but also provides the additional tools like DBMS, BI services etc.

E.g.: Apprenda, Red Hat OpenShift.

Software as a Service (SaaS): This service makes the users connect to the applications through the Internet on a subscription basis.

E.g.: Google Applications, Salesforce.

Comparison between various cloud platforms:

IoT Cloud Platform	**Real time data capture**	**Data Visualization**	**Cloud service type**	**Data Analytics**	**Developer cost**
Ubidots (https://app.ubidots.com)	Yes	Yes	Public	Yes	Free
Thingspeak (https://thingspeak.com)	Yes	Yes (Matlab)	Public	Yes	Free
Xively (https://xively.com)	Yes	Yes	Public (IoTaaS)	No	Free
Plotly (https://plot.ly/products/cloud)	Yes	Yes (Matlab)	Public	Yes	Free
Axeda (https://www.axeda.com)	Yes	Yes	Private (IaaS)	Yes	Pay per use
Phytech (https://www.phytec.in)	Yes	Yes	Private (IaaS)	Yes	Pay per use
Arkessa (https://www.arkessa.com)	Yes	Yes	Private	Yes	Pay per use
Yaler (https://www.yaler.net)	Yes	Yes	Private	Yes	Pay per use
Particle (https://console.particle.io)	Yes	Yes	Private	Yes	Pay per use
Io.adafruit (https://io.adafruit.com)	Yes	Yes	Private	Yes	Free
Thingsworx (https://developer.thingworx.com)	Yes	Yes	Private (IaaS)	Yes	Pay per use

Mostly use cloud computing service provider:

Microsoft Azure (https://azure.microsoft.com) - Rich, a user interface for entire data science, big data analytics workflow.

AWS Amazon web service (https://aws.amazon.com) - User-friendly interface for entire data science, big data analytics workflow.

Google cloud platform (https://console.cloud.google.com) - Aimed for developers to include a predictive component in their application.

IBM (https://www.ibm.com) -User-friendly interface for rich data summaries, explorations and visualizations.

Comparison between AWS, Azure and GCP:

Service	**AWS**	**Microsoft Azure**	**Google Cloud Platform**
Computing			
Virtual Servers	Instances	VMs	VM Instances
Instances Families	7	7	4
Instances Type Predefined	39 Current Gen, 15 Previous Gen, 54 Total	33	18
Custom Instance Types	-	-	Yes
Platform-as-a-Service	Elastic Beanstalk	Cloud Service	App Engine
Infrastructure -as-a-Service	Amazon EC2	Virtual Machines	Google compute Engine
Serverless Computing	Lambda	Azure function	Cloud function
Docker Management	ECS	Container Service	Container Engine
Kubernetes Management	EKS	Kubernetes Service	Kubernetes Engine
Storage			
Block Storage	Amazon EBS	Blob Storage	Google Compute Engine persistent disks
Object storage	S3	Azure Storage	Cloud Storage
Archive storage	Glacier	Archive Storage	Coldline
File Storage	EFS	Azure Files	ZFS / Avere
Global Content Delivery	Cloud Front	Delivery Network	Cloud CDN
Managed Data Warehouse	Redshift	SQL Warehouse	Big Query
Database			
Relational Database	Amazon RDS	Azure SQL database	Google Cloud SQL
NoSQL: Indexed	Amazon SimpleDB	Azure Table storage	Google Cloud Datastore

Bluetooth 5 module comparison:

Module	GC-BT832	GC-BT832F	GC-BT832X	GC-BC832
Soc	nRF52832 QFAA	nRF52832 QFAA	nRF52832 CIAA	nRF52832 CIAA
Flash/RAM	512KB/64KB	512KB/64KB	512KB/64KB	512KB/64KB
GPIO	32 Configurable	32 Configurable	32 Configurable	32 Configurable
Pins	40, CAS/LGA	40, CAS/LGA	40, CAS/LGA	40, CAS/LGA
Sizes	14 x 16 x 2.0 mm	15 x 20.8 x 1.9 mm	15 x 28 x 2mm	14 x 16 x 2.0 mm
Bluetooth Range	100 Meters	220/330 Meters	1250 Meters	100 Meters
BT Antenna	PCB Trace	PCB Trace	PCB Trace	PCB Trace
Peak Current	7.5mA at +4dBm TX	7.5mA at +4dBm TX	95mA at +20dBm TX	5.4mA, RX
Operation Temperature	-40ºC to 85ºC (-40ºF to 185ºF)	-40ºC to 85ºC (-40ºF to 185ºF)	-40ºC to 85ºC (-40ºF to 185ºF)	-40ºC to 85ºC (-40ºF to 185ºF)
Operation Voltage	1.7V-3.6V	1.7V-3.6V	1.8V-3.6V	1.7V-3.6V
Certification	FCC, IC	FCC, IC	Pending	FCC, IC

BT832X- the Longest-Range Bluetooth 5 Module:

- Both antennas at 4.2 meters above ground, average range is 1140 meters.
- Both antennas at 1.52 meters (5 feet, typical height of thermostat in the USA), range is 1120 meters.
- At high obstruction, BT832X range degradation is much smaller than other modules.
- With +20 dBm TX, BT832X is much better in wall penetration than other modules for indoor applications.

Specifications:

- Nordic nRF52832 QFAA with ARM Cortex M4F (M4 for nRF52810 module)
- 512 KB flash, 64 KB RAM (192KB flash/64 KBRAM for nRF52810 module)
- Complete RF solution with integrated antenna.
- TX power with antenna gain: over +20 dBm.
- NFC-A tag interface for Out Of Band pairing.
- 128-bit AES HW encryption.

- Serial Wire Debug (SWD)
- Nordic Soft Device Ready
- Over-The-Air (OTA) firmware update

32 GPIOs, firmware configurable and Peripherals:

- 12 bit/200KSps ADC, 8 configurable channels with programmable gain
- Type 2 near field communication (NFC-A) tag
- 64 level comparators
- 15 level low power comparator with wake-up from system OFF mode
- Temperature sensor
- 3x 4-channel pulse width modulator (PWM) units with EasyDMA
- Digital microphone interface (PDM)
- 5x 32-bit timers with counter mode
- Up to 3x SPI Master/Slave with Easy DMA
- Up to 2x I2C compatible 2-wire master/slave
- I2S with EasyDMA
- UART (CTS/RTS) with EasyDMA
- Programmable peripheral interconnect (PPI)
- Quadrature Demodulator (QDEC)
- AES HW encryption with EasyDMA
- Autonomous peripheral operation without CPU intervention using PPI and Easy DMA
- 3x real time counter (RTC)

Power:

- Operation voltage: 1.7V to 3.6V
- 0.4 uA OFF mode, 1.8 uA idle

Miscellaneous:

- Operation Temperature: -40°C to +85°C
- Integrated shield to resist EMI
- Sizes: 15x28x1.9mm

Cellular Module:

The Electron is available in three different versions:

2G version based on u-blox G350 cellular module
3G versions based on the U260 module
3G versions based on the U270 module

2G cellular characteristics for U270 modules:

Parameter	SARA-U270
Protocol Stack	3GPP Release 7
MS Class	Class B
Bands	E-GSM 900 MHz DCS (digital communication system) 1800 MHz
Power Class	Class 4 (33 dBm) for 900 band Class 1 (30 dBm) for 1800 band

3G cellular characteristics for U270 modules:

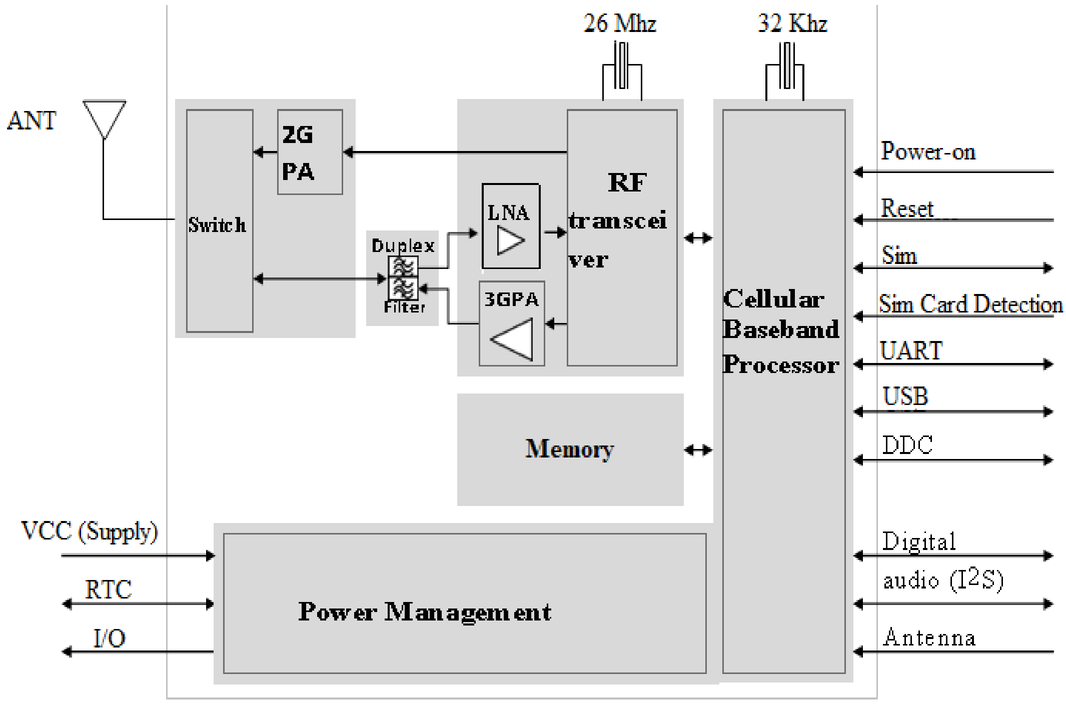
Parameter	SARA-U270
Protocol Stack	3GPP Release 7
UE Class	Class A
Bands	Band VIII (900 MHz) Band I (2100 MHz)
Power Class	Class 3 (24 dBm) for all bands

The SARA-U2 series modules are a 3.75G UMTS/HSPA solution with GSM/(E)GPRS fall-back in the miniature (26.0 x 16.0 mm, 96-pin) SARA LGA form factor that allows seamless drop-in migration from/to other u-blox cellular modules families.

SARA-U2 modules feature HSPA data-rates of 7.2 Mbit/s (downlink) and 5.76 Mbit/s (uplink). The modules offer data and voice communication over an extended operating temperature range of –40 °C to +85 °C, with low power consumption and a rich feature set including dual-stack IPv4 / IPv6.

SARA-U2 modules support full access to u-blox GNSS receivers via the serial port. Thus any host processor connected to the cellular module through a single serial port can control both the cellular module and the positioning chip/module.

Block Diagram:



SARA-U260 and SARA-U270 Block Diagram

GPS (Global Positioning System):

uBlox M8 engine GNSS receiver:

The MAX-M8 series of concurrent GNSS modules are built on the high performing u-blox M8 GNSS engine in the industry proven MAX form factor. The modules can concurrently receive up to three GNSS systems (GPS/Galileo) together with BeiDou or GLONASS). The MAX-M8 modules recognize multiple constellations simultaneously and provide outstanding positioning accuracy in scenarios with urban canyon or weak signals. The modules offer high performance even at low power consumption levels. For even better and faster positioning improvement, the MAX-M8 modules support augmentation of QZSS and IMES together with WAAS, EGNOS, MSAS, and GAGAN. The MAX-M8 modules support message integrity protection, Geofencing, and spoofing detection with configurable interface settings to easily fit to customer applications. The MAX form factor allows easy migration from previous MAX generations.
u-blox MAX-M8 modules use GNSS chips qualified according to AEC-Q100, are manufactured in ISO/TS 16949 certified sites, and fully tested on a system level. Qualification tests are performed as stipulated in the ISO16750 standard: “Road vehicles – Environmental conditions and testing for electrical and electronic equipment”.

MAX-M8 modules are available in three product variants:

- MAX-M8C is optimized for cost sensitive applications and has the lowest power consumption.
- MAX-M8Q provides best performance for passive and active antennas designs. It is also halogen free (green) which makes it perfectly suited for consumer applications.
- MAX-M8W provides best performance and is optimized for active antennas.

The modules combine a high level of integration capability with flexible connectivity options in a miniature package. This makes it perfectly suited for industrial applications with strict size and cost requirements. The I2C compatible DDC interface provides connectivity and enables synergies with most u-blox cellular modules. The u-blox MAX-M8 modules can also benefit from the u-blox AssistNow assistance service. The Online service provides GNNS broadcast parameters, e.g. ephemeris, almanac plus time or rough position to reduce the receiver’s time to first fix significantly and improve acquisition sensitivity. The extended validity of AssistNow Offline data (up to 35 days) and AssistNow Autonomous data (up to 3 days) provide faster acquisition after a long off time.

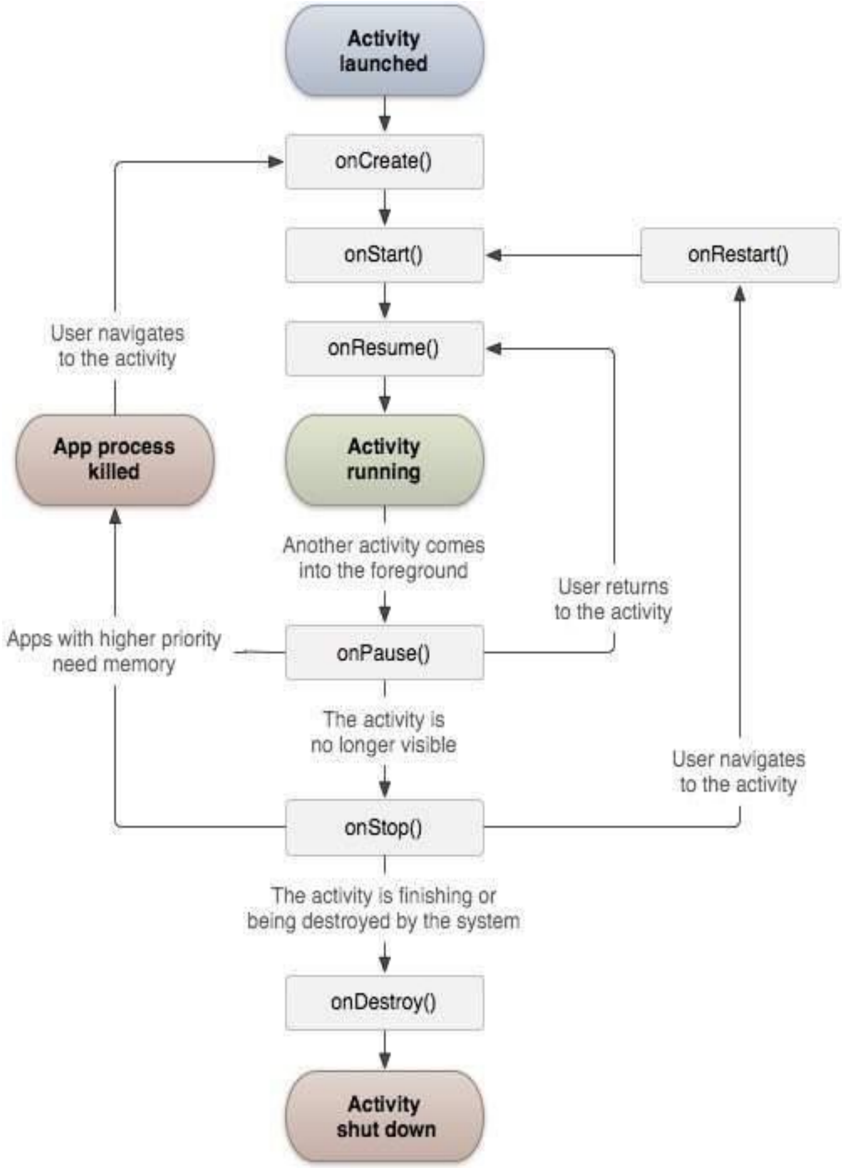
Android Application:

Android apps can be written using Kotlin, Java, and C++ languages. The Android SDK tools compile your code along with any data and resource files into an APK, an Android package, which is an archive file with an .apksuffix. One APK file contains all the contents of an Android app and is the file that Android-powered devices use to install the app.

Each Android app lives in its own security sandbox, protected by the following Android security features:

- The Android operating system is a multi-user Linux system in which each app is a different user.
- By default, the system assigns each app a unique Linux user ID (the ID is used only by the system and is unknown to the app). The system sets permissions for all the files in an app so that only the user ID assigned to that app can access them.
- Each process has its own virtual machine (VM), so an app's code runs in isolation from other apps.
- By default, every app runs in its own Linux process. The Android system starts the process when any of the app's components need to be executed, and then shuts down the process when it's no longer needed or when the system must recover memory for other apps.

Activity Life cycle:

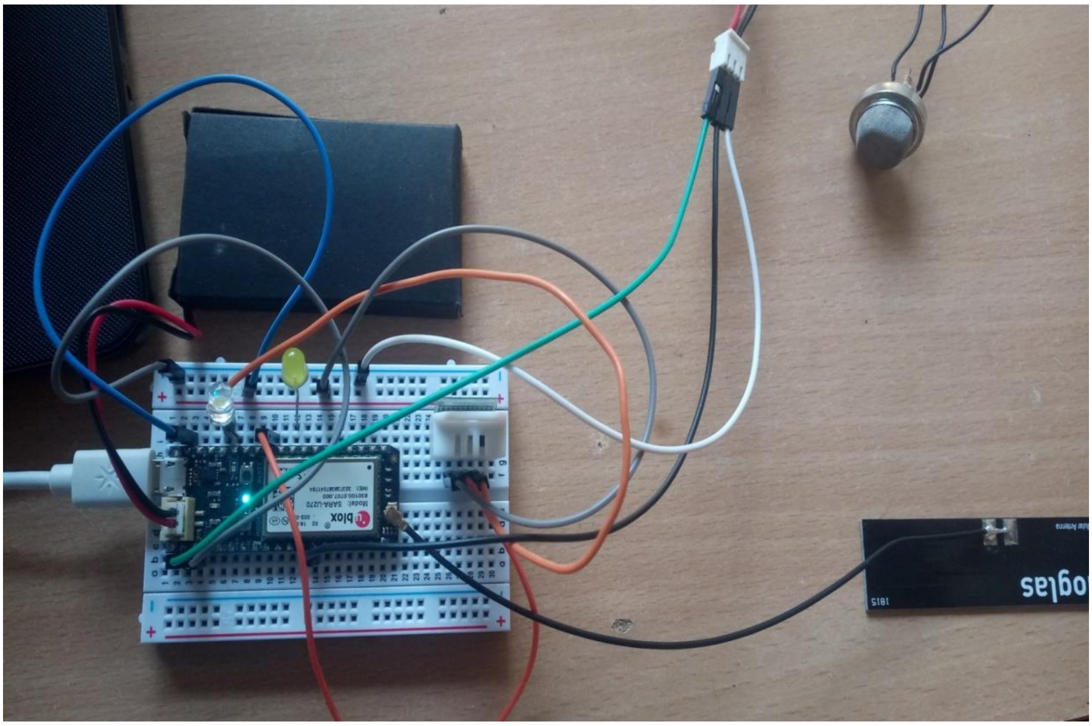


Chapter 6

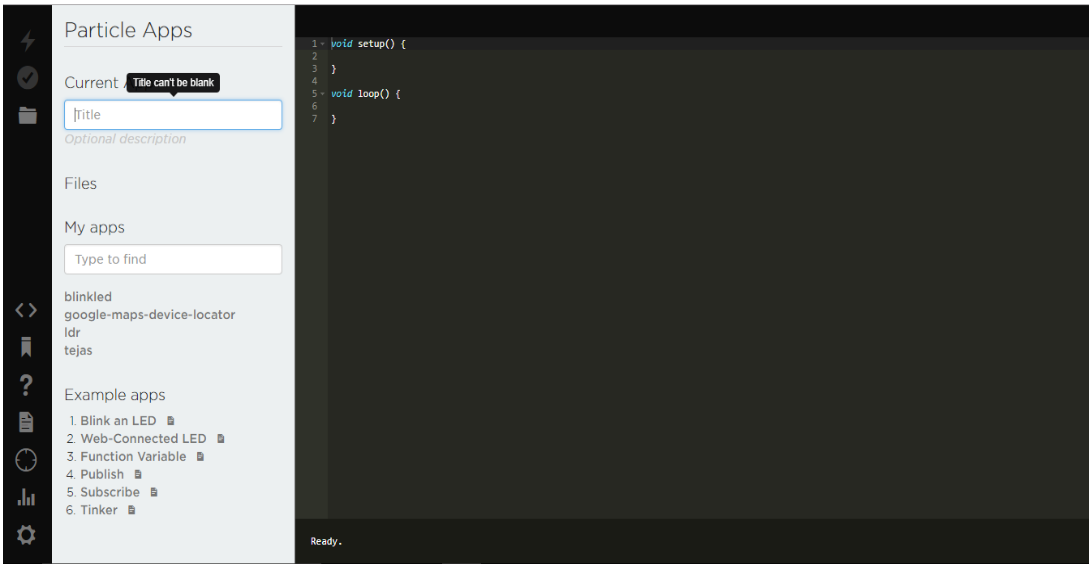
Hardware Implementation

In this chapter a revision of the work developed and the results obtained in this project will be presented.

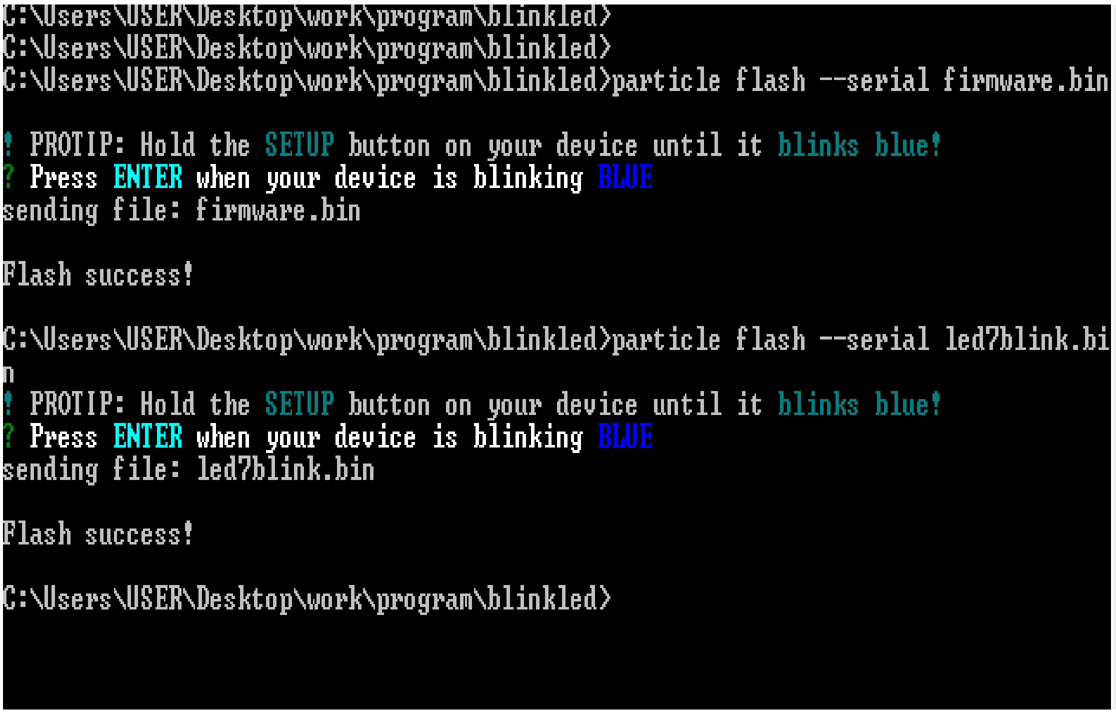
Interfacing of sensor with development board



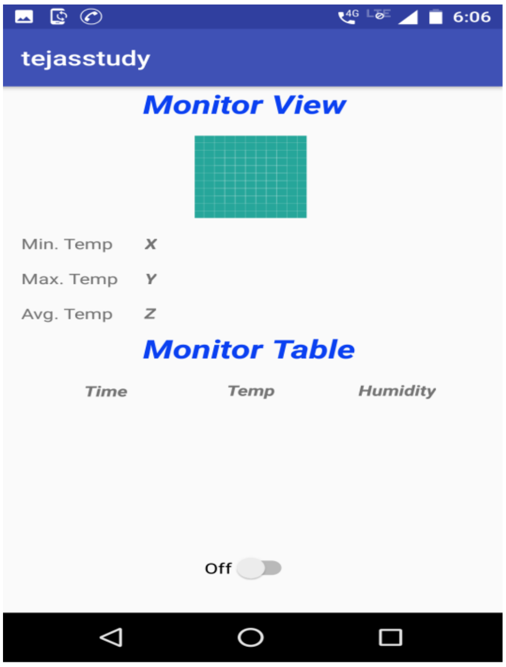
Cloud Computing:

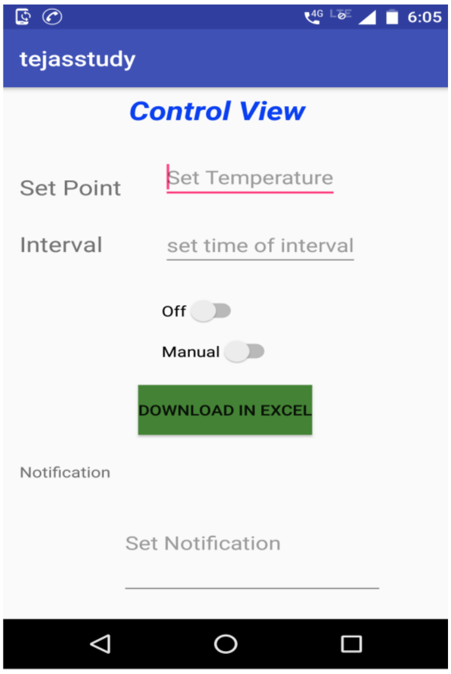


Node.js Command prompt



GUI in Android Studio



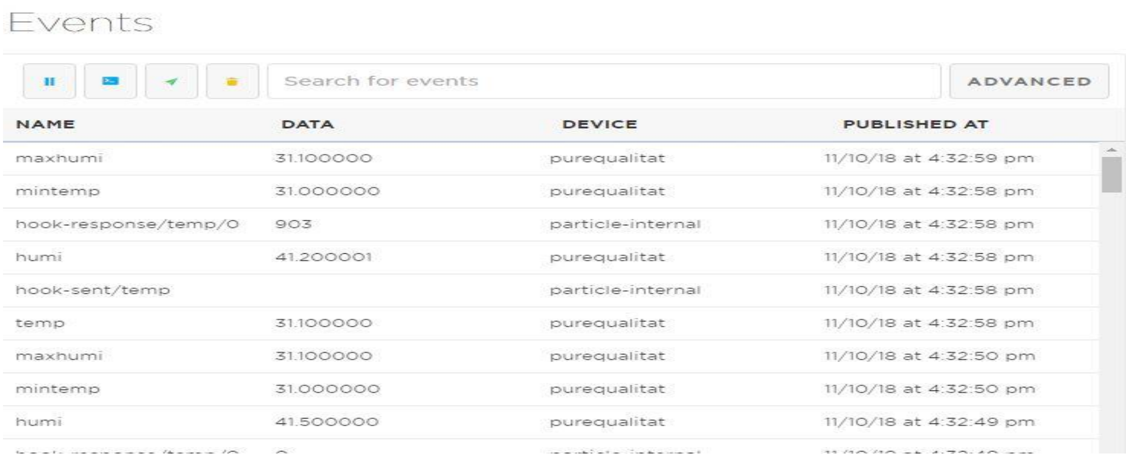


Chapter 7

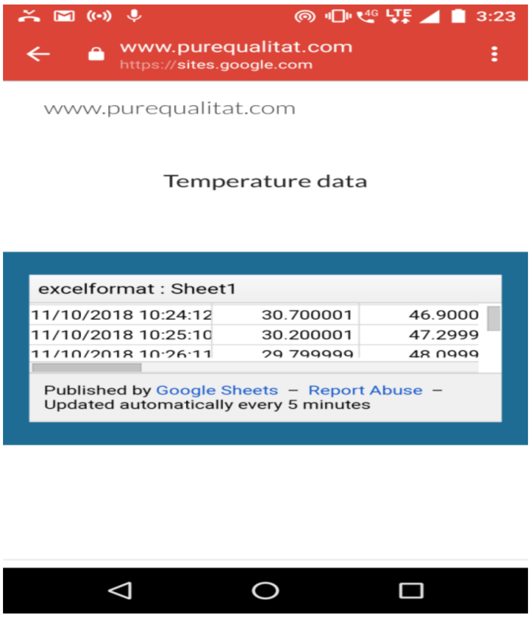
Results

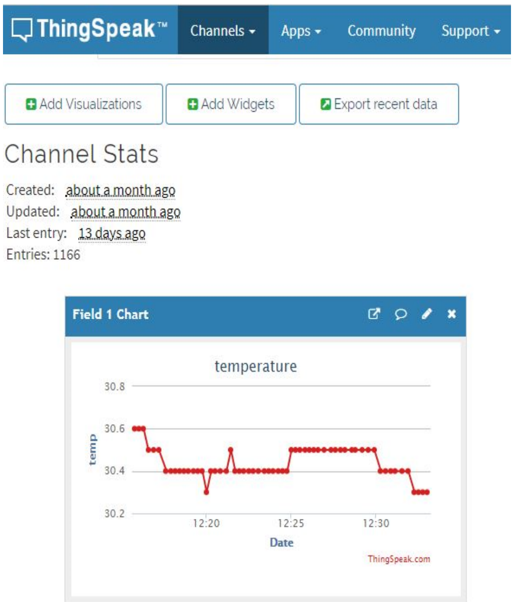
Output on Putty Terminal

Cloud Console

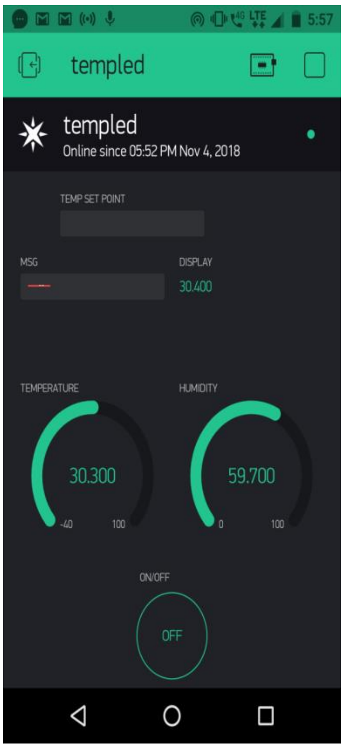


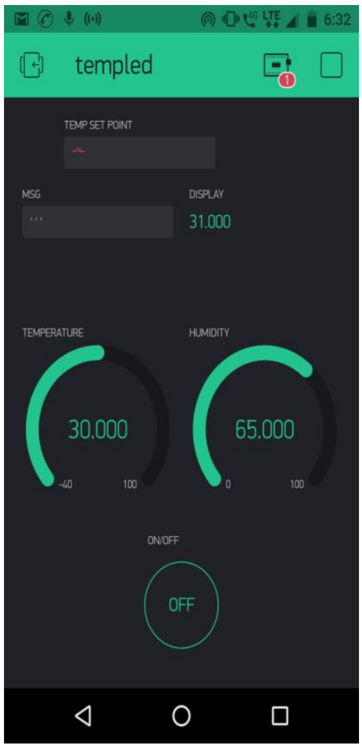
Web Page and ThingSpeak



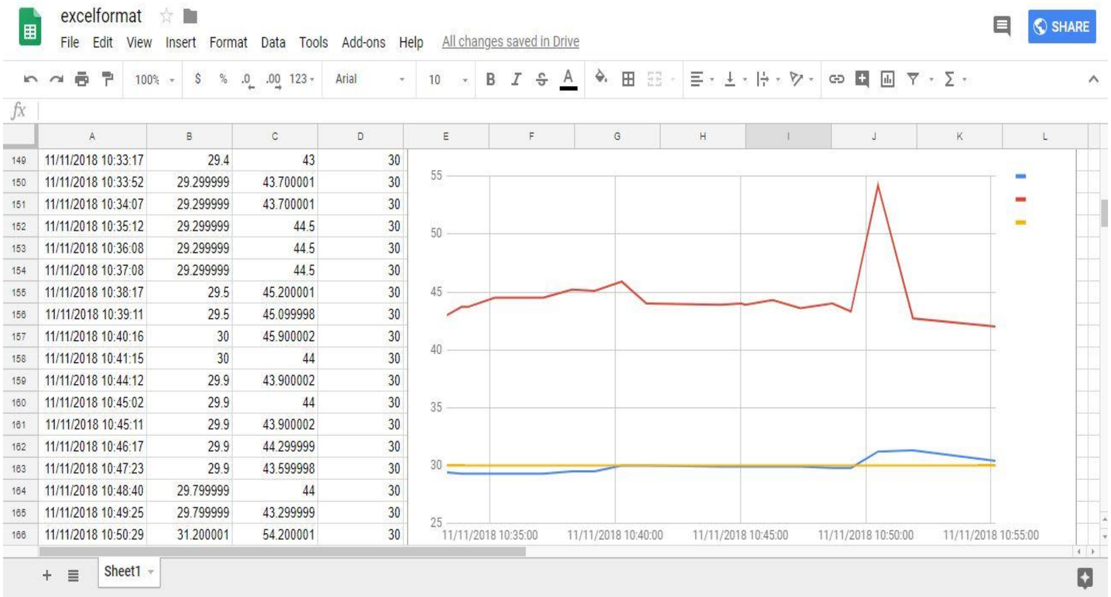


Blynk Application





Output on Excel Format



	A	B	C	D
149	11/11/2018 10:33:17	29.4	43	30
150	11/11/2018 10:33:52	29.299999	43.700001	30
151	11/11/2018 10:34:07	29.299999	43.700001	30
152	11/11/2018 10:35:12	29.299999	44.5	30
153	11/11/2018 10:36:08	29.299999	44.5	30
154	11/11/2018 10:37:08	29.299999	44.5	30
155	11/11/2018 10:38:17	29.5	45.200001	30
156	11/11/2018 10:39:11	29.5	45.099998	30
157	11/11/2018 10:40:16	30	45.900002	30
158	11/11/2018 10:41:15	30	44	30
159	11/11/2018 10:44:12	29.9	43.900002	30
160	11/11/2018 10:45:02	29.9	44	30
161	11/11/2018 10:45:11	29.9	43.900002	30
162	11/11/2018 10:46:17	29.9	44.299999	30
163	11/11/2018 10:47:23	29.9	43.599998	30
164	11/11/2018 10:48:40	29.799999	44	30
165	11/11/2018 10:49:25	29.799999	43.299999	30
166	11/11/2018 10:50:29	31.200001	54.200001	30

Chapter 8

Work to be done

- Implementation of PCB Design.
- Assembly of components and placement.
- Designing wireless sensor for the system.
- Implement of cloud computing and Android Application.
- Testing of entire system.

Chapter 9

References

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