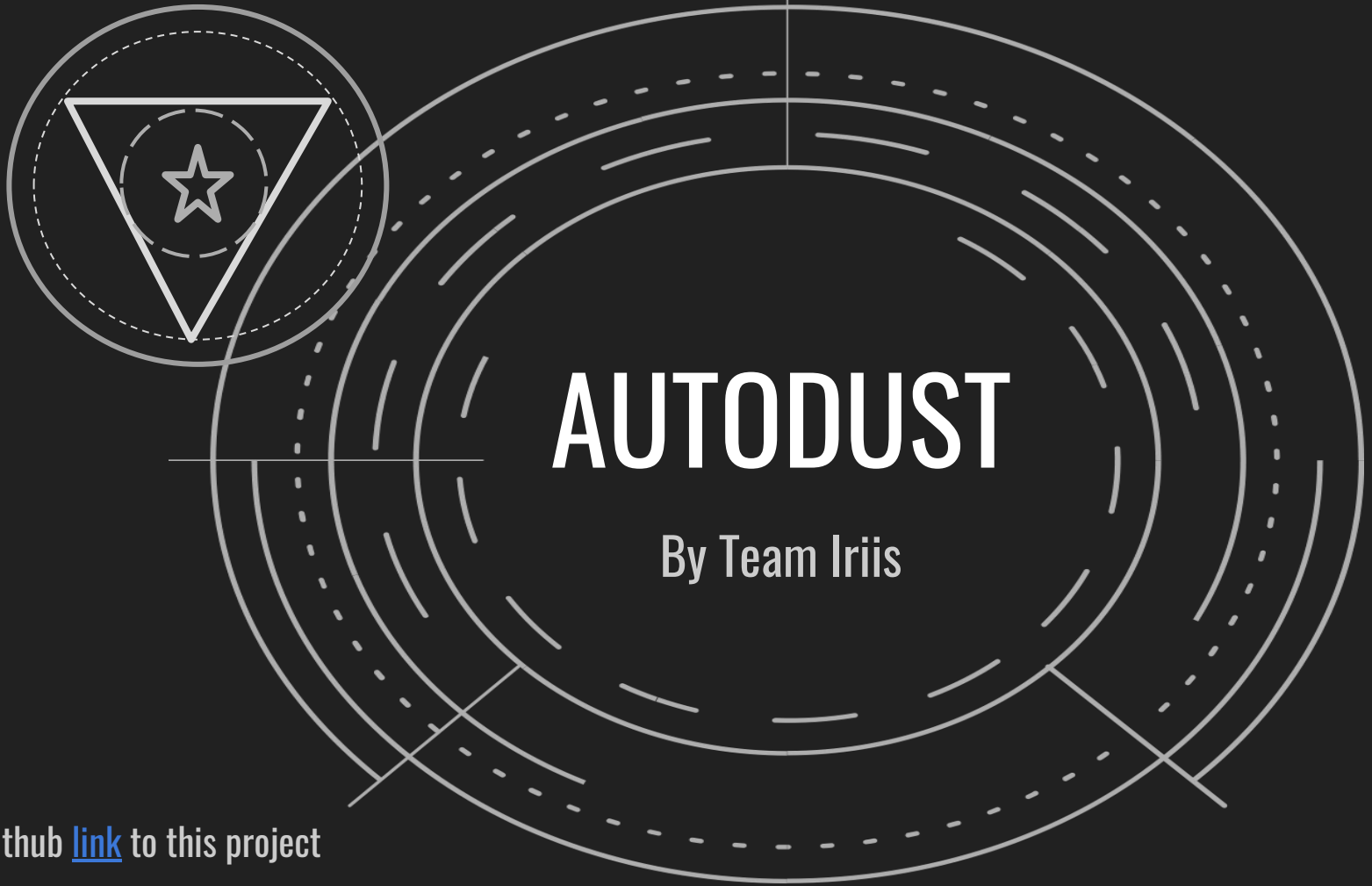
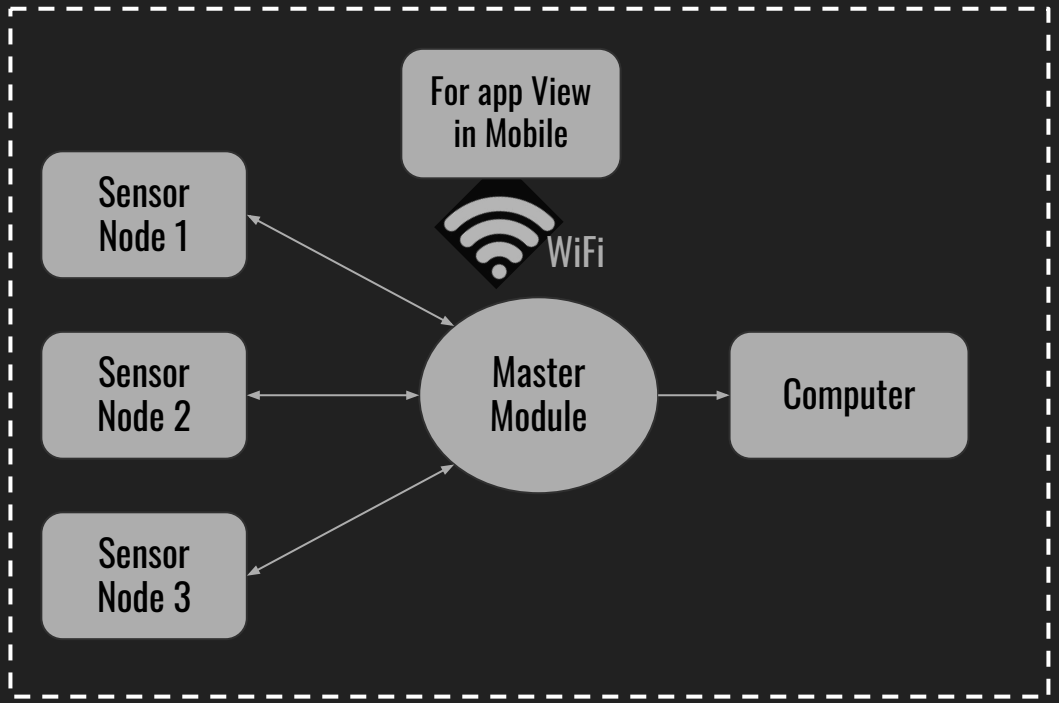


AUTODUST

By Team Iriis

Github link to this project

Proposed Design

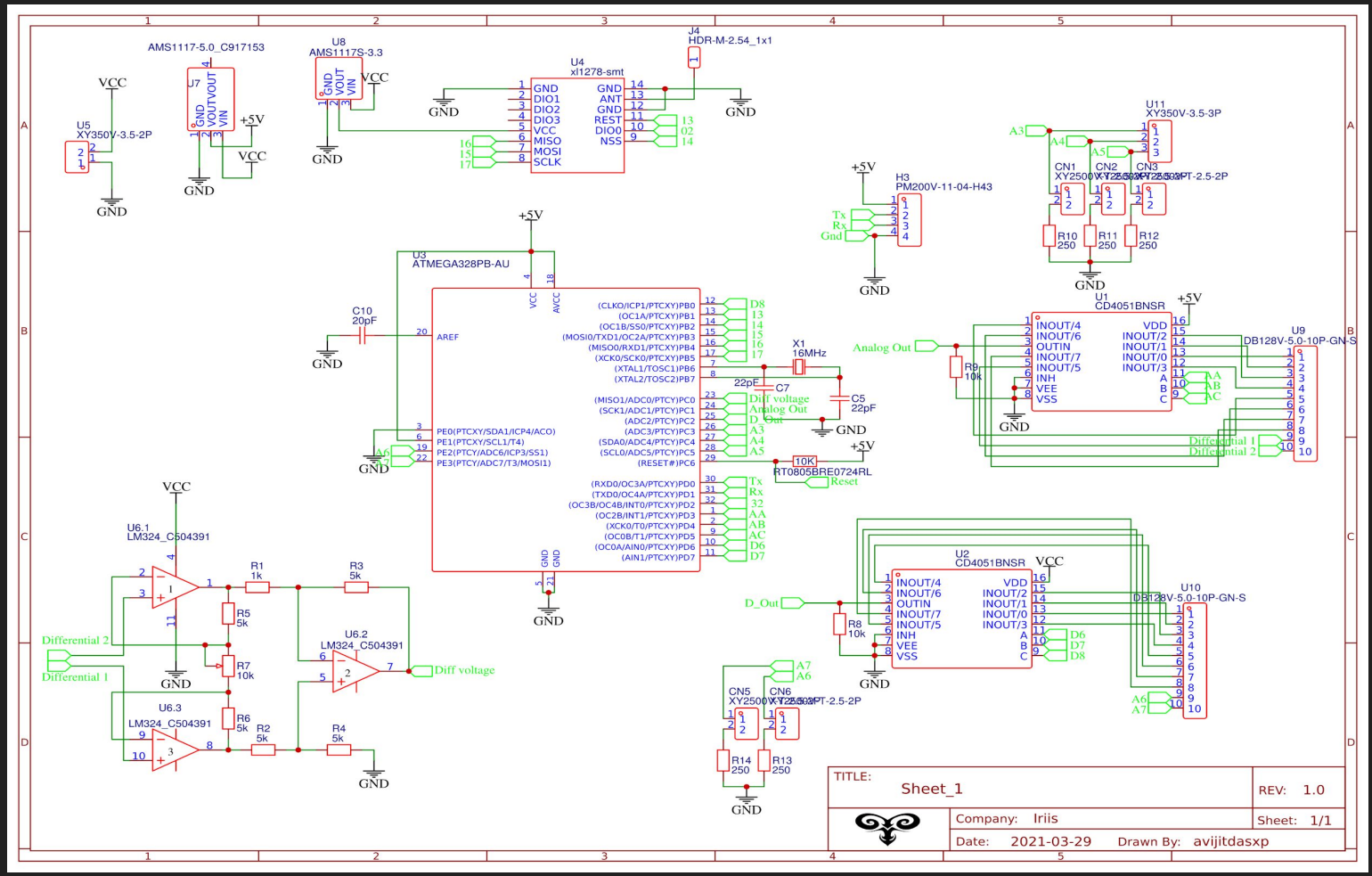


NB: More than one sensor can be multiplexed at the node to reduce cost.

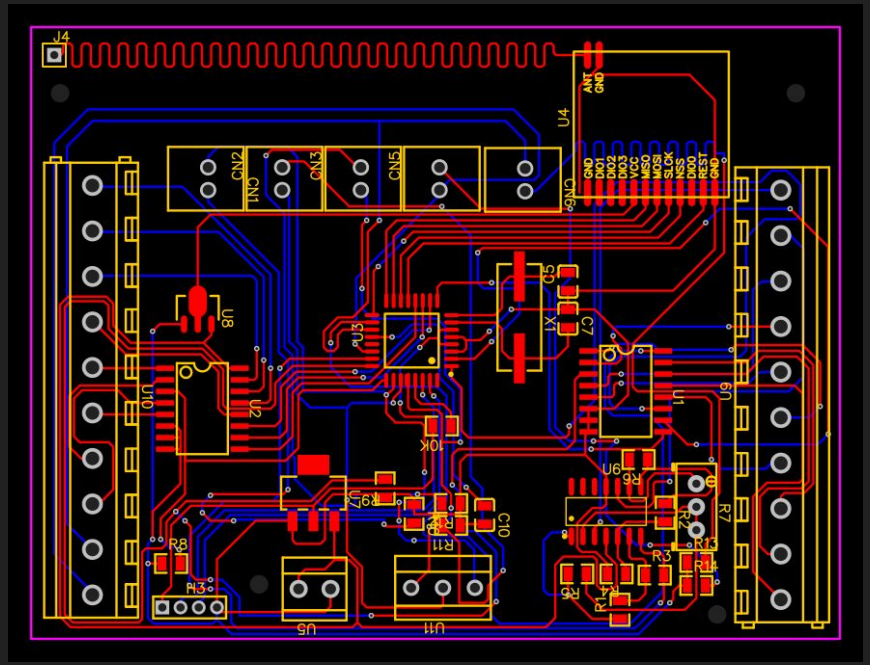
Every sensor will be connected to LoRa modules, so that the physical data from the sensors will get transmitted and received by a master module, where the module will change its frequency by multiplexing the sensor readings, and will transmit it over serial communication to a computer for graphical view of the sensor data.

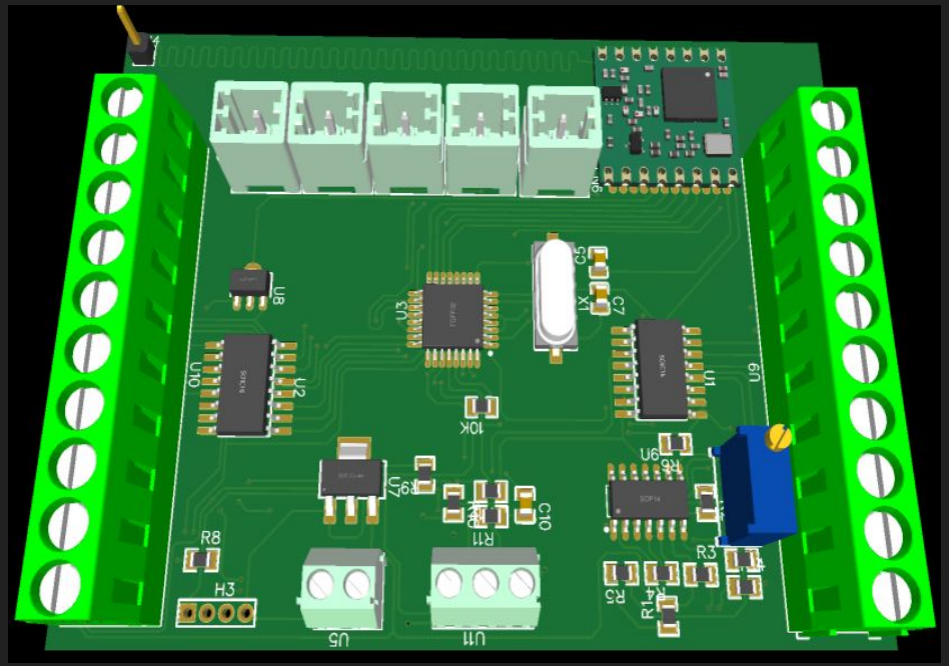
The master will also has a wifi connectivity through which mobiles could be connected, in which, the readings can be visualized using an application.

Schematic Of Sensor Nodes



PCB Design And 3D Model Of Sensor Nodes





Refer to the Github link for the complete project including the Gerber files :)

Features

Features of the Sensor Nodes:

- Low power
- Long range
- High fidelity and Robust design
- 14 Analog inputs and 8 Digital inputs with differential and current loop support
- Wide input voltage range

Features of the Master Module:

- High speed (240 MHz)
- Long range
- Simple interface with computer hardware
- In-built WiFi
- Robust design and High fidelity
- Data backup capability upto 2 days
- Easy connectivity over USB

Software Features:

- Easy GUI implementation
- Integrated database
- Support of adding multiple graphs in a single window.

Cost Of The Prototype Per Unit

The value depends on the amount of nodes connected.

Each node consists of a SX1278 LoRa transceiver which costs 350 Inr.

The sensors data needs to be read, filtered and processed so a microcontroller is perfect suitable. PIC or AVR is cheap, versatile and low power which costs 90 Inr.

Analog Multiplexers CD4051 is used for multiplexing many sensors to a single ADC which costs 6Inr.

For each node the complementary components uses around 30 Inr.

Appx cost of each node will around 550 Inr. with the PCB.

The Master module will also contain a LoRa transceiver and a microcontroller and a USB to UART converter to send the data signals from the microcontroller of the Master module to the computer. So for the microcontroller, with a WiFi connectivity inbuilt, Esp12e is a versatile, high speed(240mHz) and stable chip for this operation which costs 180Inr and again the LoRa costs 350Inr, so the total cost of the master module is appx 650Inr with complementary components and PCB.

List Of Materials

ID	Name	Designator	Footprint	Quantity	Manufacturer Part
1	10k	R1	R0805	1	RT0805BRE0724RL
2	22pF	C5,C7	C0805	2	TCC0805C0G200J101BT
3	20pF	C10	C0805	1	TCC0805C0G200J101BT
4	PM200V-11-04-H43	H3	HDR-TH_4P-P2.00-V-F	1	PM200V-11-04-H43
5	HDR-M-2.54_1x1	J4	HDR-M-2.54_1X1	1	
6	1k	R1	R0805	1	
7	5k	R2,R3,R4,R5,R6	R0805	5	
8	10k	R7	RES-ADJ-TH_3P-L9.5-W4.9-P2.50-L_3296W	1	3296W-1-500
9	10k	R8,R9	R0805	2	

ID	Name	Designator	Footprint	Quantity	Manufacturer Part
10	250R	R10,R11,R12	R0805	3	
11	CD4051BNSR	U1,U2	SOIC-16_L10.8-W5.5-P1.27-LS7.8-BL	2	CD4051BNSR
12	ATMEGA328PB-AU	U3	TQFP-32_L7.0-W7.0-P0.80-LS9.0-BL	1	ATMEGA328PB-AU
13	xl1278-smt	U4	XL1278-SMT	1	Semtech
14	XY350V-3.5-2P	U5	CONN-TH_XY350V-3.5-2P	1	XY350V-3.5-2P
15	LM324_C504391	U6	SOP-14_L8.6-W3.9-P1.27-LS6.0-BL	1	LM324
16	AMS1117-5.0_C917153	U7	SOT-223-3_L6.5-W3.4-P2.30-LS7.0-BR	1	AMS1117-5.0
17	AMS1117S-3.3	U8	SOT-89-3_L4.5-W2.5-P1.50-LS4.2-BR	1	AMS1117S-3.3
18	DB128V-5.0-10P-GN-S	U9,U10	CONN-TH_DB128V-5.0-10P-GN-S	2	DB128V-5.0-10P-GN-S
19	XY350V-3.5-3P	U11	CONN-TH_XY350V-3.5-3P	1	XY350V-3.5-3P
20	16MHz	X1	OSC-SMD_L11.5-W4.8-LS13.0	1	5M0-1600A2020-01

Software Integration

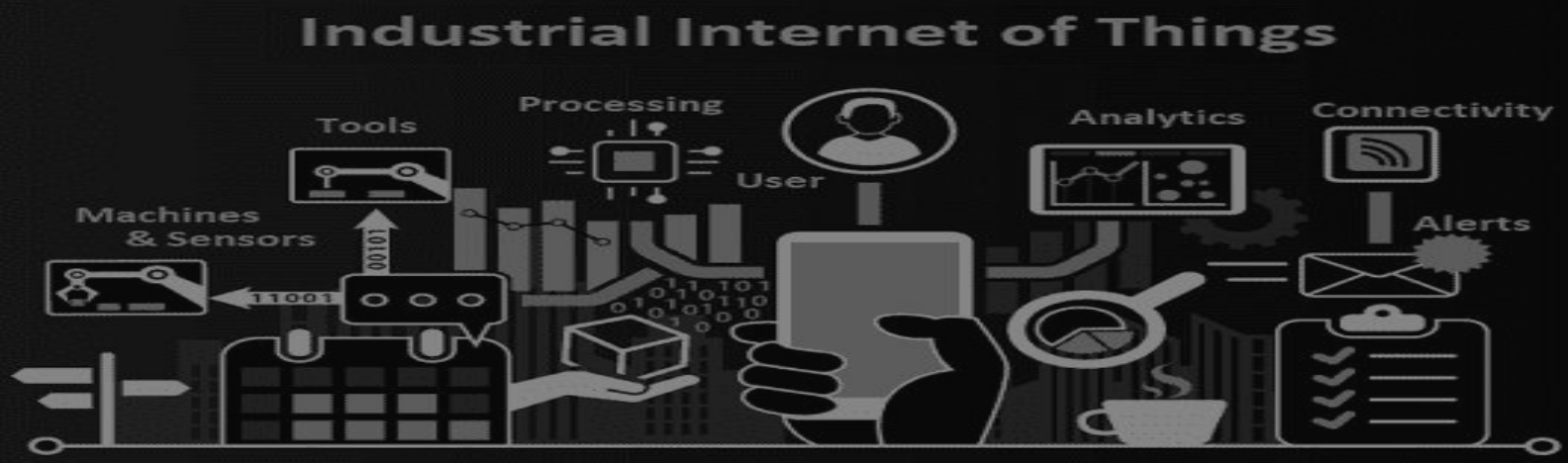
With the help of the UART communication with a Computer and the Master Module, the stream of data from the Master Module is sent to the Computer over USB.

A JAVA program is built using the SWING framework. Swing is so chosen for a user-friendly GUI desktop application. The application has an Integrated database, here it is HyperSQL DB, and with JDBC, it connects to the development of the JAVA program. The application features a base window where the monitor can add which sensor to view and can switch to the variety among them as wanted.

Due to the database capability, the software can log the data over a very long period. So that if something goes wrong in the industry, they can trace it back to when the fault had occurred, and this is very important for troubleshooting or maintenance. Even this database can be used for Predictive maintenance. With the java.net feature, we can upload the data over the Internet, and if the organization owns a domain, with the help of web development, this data can be viewed from anywhere, saying the internet connection is available. The ESP12-E board features a WiFi capability that can also upload data over the Internet. In this way, we refrain from using third-party cloud services, which is very important from the organization’s security point of view.

Longevity And Tech Stack

Due to its simple design and no complex devices are used, resulting to refraining from complicated programmes and system. Low power consumption will result to more life. The expected usage of a single module is more than a decade.



Tech Stack

1. LoRa (Wireless)
2. Microcontrollers (AVR)
3. Multiplexing
4. Instrumentation Amplifiers
5. 4-20mA Current sensor interface
6. WiFi
7. Internet Upload
8. Usb to Serial (UART)
9. GUI development (JAVA SWING)
10. Integrated Database (HSQLDB)
11. Java