Detailed Project Report

On

Development of Low-Cost Anemometer and Wind vane sensor

By:

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Chapter 1 : INTRODUCTION

Wind speed and direction are vital parameters for numerous applications. Anemometers measure wind speed while wind vanes determine wind direction. Traditional methods involve mechanical sensors prone to wear and inaccuracies. The proposed project seeks to develop advanced sensors using modern electronic and material science technologies to overcome these limitations.

The need for accurate and reliable environmental monitoring has become increasingly crucial in various fields, ranging from meteorology and renewable energy to building automation and industrial applications. Wind speed and direction are fundamental parameters in understanding and predicting weather patterns, optimizing renewable energy systems, and ensuring the safety and efficiency of various processes.

This project focuses on the development and implementation of advanced anemometer and wind vane sensors, designed to provide precise and real-time data on wind conditions. The integration of these sensors into a comprehensive environmental monitoring system aims to enhance our ability to gather, analyze, and utilize critical information related to atmospheric dynamics.

Chapter 2 : PROJECT BACKGROUND

The project aims to design, develop, and deploy anemometer and wind vane sensors for accurate measurement of wind speed and direction. These sensors are crucial for various applications including weather monitoring, renewable energy systems, agriculture, aviation, and environmental research. The project will focus on creating reliable, durable, and cost-effective sensors that can be deployed in diverse environmental conditions.

2.1 Project Objectives

The primary objective of this project is to design, develop, and implement a state-of-the-art anemometer and wind vane sensor system capable of delivering accurate and reliable measurements of wind speed and direction. The project seeks to address the following specific goals:

1. **Accuracy and Precision:** Develop sensors with a high degree of accuracy and precision to ensure reliable data for meteorological and industrial applications.
2. **Integration:** Integrate the anemometer and wind vane sensors seamlessly into existing environmental monitoring networks, enabling efficient data collection and analysis.
3. **Compatibility:** Ensure compatibility with modern communication protocols and connectivity options, allowing for easy integration with IoT platforms and other data management systems.
4. **Environmental Resilience:** Design sensors that can withstand a range of environmental conditions, including extreme temperatures, humidity, and exposure to various elements.
5. **User-Friendly:** Create a user-friendly interface for configuring, monitoring, and extracting data from the sensors, facilitating ease of use for both professionals and researchers.

2.2 Significance of the Project

The successful implementation of this project holds several significant implications:

1. **Improved Weather Forecasting:** Accurate wind data contributes to better weather forecasting models, aiding meteorologists in predicting and managing severe weather events.

2. **Enhanced Renewable Energy Optimization:** The data provided by the sensors can be utilized to optimize the performance of wind turbines and other renewable energy systems, increasing overall efficiency.
3. **Safety and Environmental Monitoring:** The sensors can be employed in industrial settings to enhance safety measures and monitor environmental conditions, ensuring compliance with regulatory standards.
4. **Research and Development:** Researchers can utilize the collected data for a wide range of studies, contributing to a deeper understanding of atmospheric conditions and their impact on various ecosystems.

Chapter 3: TECHNICAL OVERVIEW

The technical aspects of this project include: Design specifications, Architecture, Hardware Implementation.

3.1 Design Specifications

- The anemometer consists of a freely rotating three-cup based structure with another cylindrical PVC structure for the base.
- The wind vane sensor consists of a freely rotating arrow-based structure made using an aluminium sheet pipe and PVC along with another cylindrical PVC structure as the base.
- The anemometer uses a magnetic Hall sensor that uses the principle of electromagnetic induction to detect the magnetic field from a permanent neodymium magnet equipped at the circumference of the cup structure. It can measure wind speeds accurately as the sensor output is interfaced at 12-bits with a very low response time.
- The wind vane sensor also uses magnetic Hall sensors in eight major directions to determine the wind direction. Also, a variable resistor is also used to accurately determine the exact angle of wind. The Hall sensors are interfaced at 12-bits whereas the variable resistor is interfaced at 16-bits using an external ADC (Analog to Digital Converter).
- Moderate size, easy to setup and can be easily integrated with other sensors and microcontrollers.

3.2 Architecture

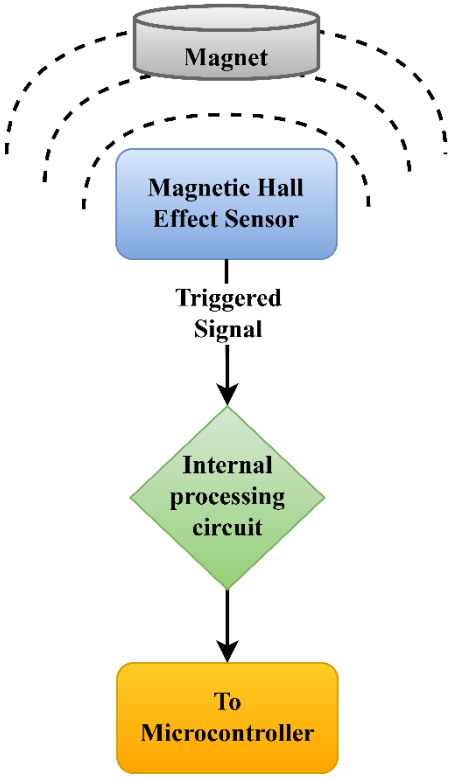

Fig. Basic working architecture of Anemometer

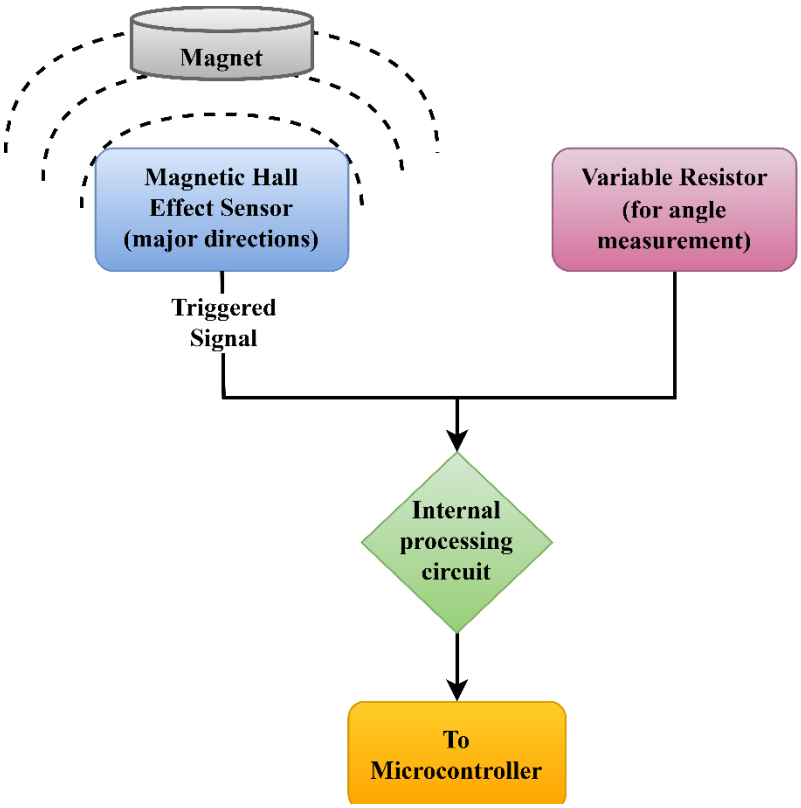

Fig. Basic working architecture of Wind Vane

3.3 Hardware Implementation

The structure of the anemometer is made using good quality PVC with the top cup-based structure 3D printed using PTEG filament to make it durable and weatherproof. Few 3mm neodymium magnets are fitted in one compartment under the cup-based structure. For free rotation of the structure, two 10mm metal ball bearings are fitted with a nut that work as the shaft of the structure.

The base of the sensor consists of a cylindrical PVC part that has the magnetic Hall sensor along with its interfacing circuit that generates a low signal when triggered. The total structure is completely sealed to make it waterproof and prevent short circuit in the internal circuitry. Only three wires are kept out from the structure to interface it with microcontrollers.

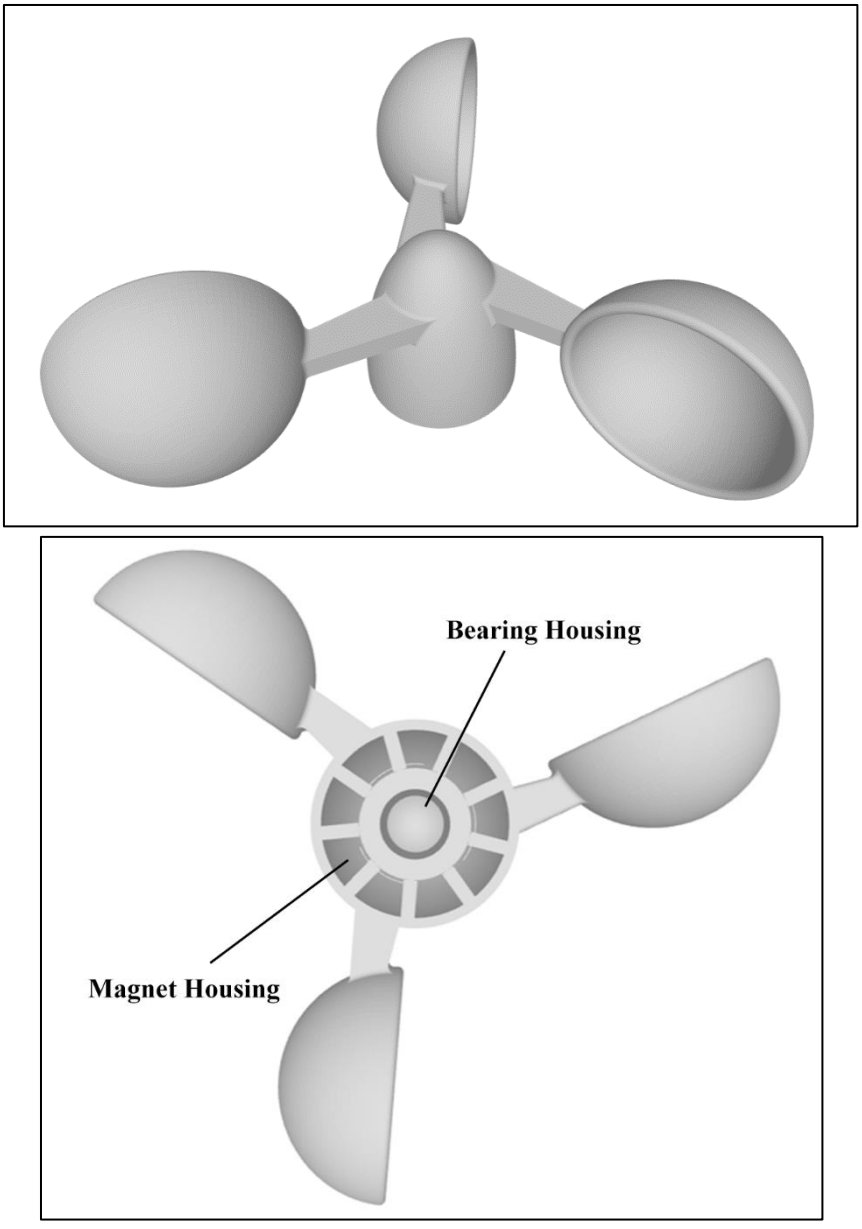

Fig. Anemometer rotating part design

The structure of the wind vane is made using PVC and a lightweight aluminium sheet pipe. The top arrow structure is made using the lightweight aluminium pipe as the body and a cone-shaped structure made using epoxy glue as the tip of the arrow. The tail is made using a PVC sheet to make it lightweight so that the arrow can move along the direction of the wind.

A 23mm diameter PVC pipe is used for the shaft of the sensor above which the arrow structure is fitted. A 5mm neodymium magnet is fitted at the bottom part of the shaft along the direction of the arrow tip. The shaft is connected to a 52mm metal ball bearing for free rotation of the arrow structure.

The base of the sensor consists of a cylindrical PVC part that has the magnetic Hall sensors along the eight major directions, with an interfacing circuit that generates a low signal depending on which sensor is triggered. The variable resistor is equipped underneath the circuit. The total structure is completely sealed to make it waterproof and prevent short circuit in the internal circuitry. A few wires are kept out from the structure to interface it with microcontrollers.

For the internal circuitry of the sensors, an interfacing circuit is used that processes the signals generated when hall effect sensors are triggered to remove any noise in the circuit and to ensure that it can be interfaced easily with a microcontroller with low complexity.

The interfacing circuit for both the sensors are currently under development, implementing different solutions to meet the desired requirements with less interfacing complexity and at a budget-friendly method.

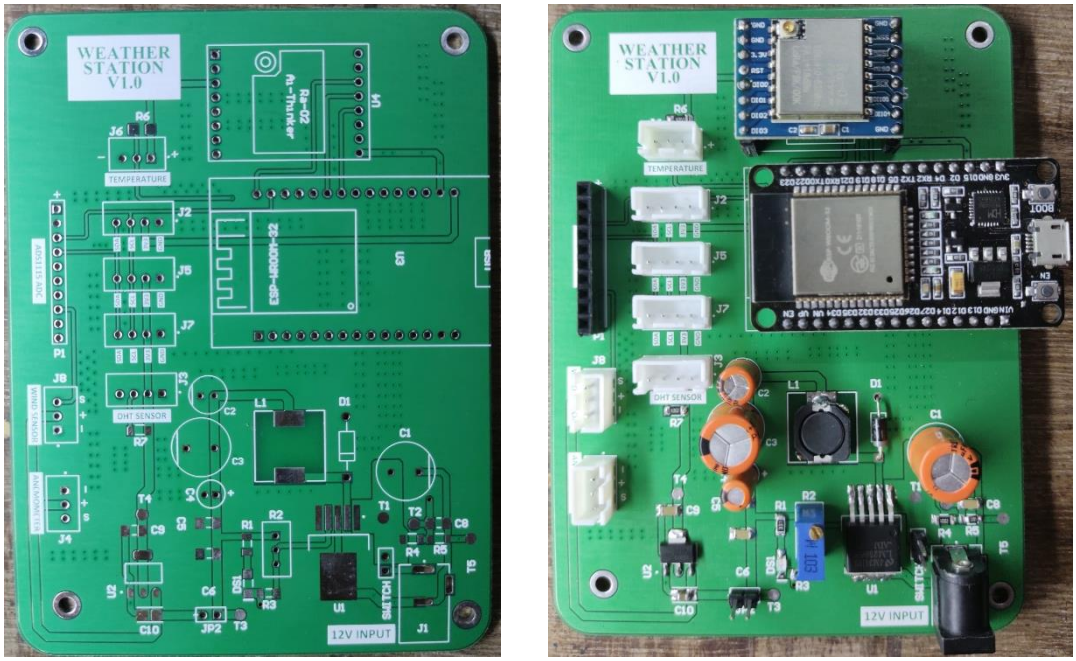

Fig. Sensor interfacing PCB

Chapter 4: EXPENSES OVERVIEW

Order details

Product	Total
Radial Ball Bearing 685ZZ for 3D Printer/ Robot - 4Pcs **× 1**	₹ 71.00
GY-BME280-3.3 Precision Altimeter Atmospheric Pressure Sensor Module **× 1**	₹ 579.00
GY-30 BH1750FVI Digital Light Intensity Illumination Sensor **× 1**	₹ 172.00
Subtotal:	₹ 822.00
Shipping:	STANDARD SHIPPING
Payment method:	UPI | Credit | Debit Card | NetBanking | Wallets | EMI | Amazon Pay
Total:	₹ 822.00

Order again

Billing address

Ritam Majumder
Salil bose nagar, 2 no rail gate
Barasat 743248
West Bengal
8017483866

majumder.ritam.02@gmail.com

Shipping address

Ritam Majumder
Salil bose nagar, 2 no rail gate
Barasat 743248
West Bengal

Order details

Product	Total
Adafruit LTR390 UV Light Sensor - STEMMA QT/Qwiic **× 1**	₹ 599.00
DHT22/AM2302 Digital Temperature & Humidity Sensor **× 1**	₹ 186.00
MT76813DBI ESP8266 Serial WIFI wireless Gain Antenna **× 2**	₹ 138.00
Subtotal:	₹ 923.00
Discount:	-₹ 39.00
Shipping:	STANDARD SHIPPING
Payment method:	UPI | Credit | Debit Card | NetBanking | Wallets | EMI | Amazon Pay
Total:	₹ 884.00

Order again

Billing address

Ritam Majumder
Salil bose nagar, 2 no rail gate
Barasat 743248
West Bengal
8017483866

Shipping address

Ritam Majumder
Salil bose nagar, 2 no rail gate
Barasat 743248
West Bengal

Order details

Product	Total
Online FDM 3D Printing Service × 1 • **Printer:** 0.15 mm Medium Quality • **Infill:** 20% • **Filename:** Anaemometer.stl • **P3D Material:** ASA - Black • **P3D Model:** 64f08875673c8_a4884ea3853a3e61cd8dd032503d448e.stl • **Unit:** mm • **Scale:** ×1 (10.75 × 11.49 × 4.5 cm)	₹ 741.00
Subtotal:	₹ 741.00
Shipping:	₹ 99.00 via STANDARD SHIPPING
Payment method:	UPI | Credit | Debit Card | NetBanking | Wallets | EMI | Amazon Pay
Total:	₹ 840.00

Order again

TAX INVOICE (Original for Recipient)

ROBU.IN
Your Ideas, Our Parts
https://www.facebook.com/robulabs
https://plus.google.com/+Robulinlabs

MACFOS LIMITED
(Formerly known as MACFOS PVT LTD)
Sumant Building, Dynamic Logistics Trade Park
Survey No. 78/1 Dighi, Bhosari Alandi Road Pune 411015
Maharashtra MH
India
02068197600
CIN: U29309PN2017PLC172718
info@robu.in
GSTIN: 27AALCM3536H1ZA

Customer	Shipping Address
Ritam Majumder	**Ritam Majumder**
Salil bose nagar, 2 no rail gate	Salil bose nagar, 2 no rail gate
Chandrapur, Duttapukur Barasat, 743248 West Bengal,WB, India	Chandrapur, Duttapukur Barasat, 743248 West Bengal,WB, India
8017483866	8017483866
majumder.ritam.02@gmail.com	majumder.ritam.02@gmail.com

Place of Supply: 19 - West Bengal

Invoice# INV2324/125640

Invoice Date: 02/09/2023
Sale Order: 1723592

Reference: INV2324/125640

	Description	HSN	Rate	Qty	Disc	Amount	IGST	Total
1	[13625] Rubber Sealed Ball Bearing Miniature Bearing	84725000	₹ 40.0000000	1.00	₹ 0.00	₹ 40.00	₹ 7.20 (18.0%)	₹ 47.00
2	[43647] YF-SX1278 LoRa Module Ra- 02 433MHZ Wireless Spread Spectrum Transmission	84715000	₹ 427.000000	2.00	₹ 0.00	₹ 854.00	₹ 153.70 (18.0%)	₹ 869.00
3	[26300] LCD2004 Parallel LCD Display with IIC/I2C Interface	90138010	₹ 301.690000	1.00	₹ 0.00	₹ 301.69	₹ 54.31 (18.0%)	₹ 356.00

4	[31314] A3144 Hall Effect Sensor Module	84715000	₹ 35.340000	8.00	₹ 0.00	₹ 282.72	₹ 50.88 (18.0%)	₹ 333.00
5	[std_shipping] STANDARD SHIPPING	996819	₹ 0.000000	1.00	₹ 0.00	₹ 0.00	₹ 0.00 (18.0%)	₹ 0.00
				Total:	13.000			

Item	Taxes	Amount
1	18% IGST (Sale)	₹ 266.09

Subtotal	₹ 1338.91
Taxes	₹ 266.09
Total	₹ 1,605.00

Amount in Words: ONE THOUSAND SIX HUNDRED FIVE INDIAN RUPEE
Payment terms: Immediate Payment

ROBU.IN
Your Ideas, Our Parts
https://www.facebook.com/robulabs
https://plus.google.com/+RobuInlabs

MACFOS LIMITED
(Formerly known as MACFOS PVT LTD)
Sumant Building, Dynamic Logistics Trade Park
Survey No. 78/1 Dighi, Bhosari Alandi Road Pune 411015
Maharashtra MH
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02068197600
CIN: U29309PN2017PLC172718
info@robu.in
GSTIN: 27AALCM3536H1ZA

Customer

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India
8017483866
majumder.ritam.02@gmail.com

Place of Supply: 19 - West Bengal

Shipping Address

Ritam Majumder
Salil bose nagar, 2 no rail gate
Chandrapur, Duttapukur
Barasat, 743248
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India
8017483866
majumder.ritam.02@gmail.com

Invoice# INV2324/127977

Invoice Date: 05/09/2023
Sale Order: 1726480

Reference:
INV2324/127977

	Description	HSN	Rate	Qty	Disc	Amount	IGST	Total
1	[13625] ESP-WROOM-32 WIFI Bluetooth Networking Smart Component Board	84725000	₹ 335.000000	2.00	₹ 0.00	₹ 670.00	₹ 120.6 (18.0%)	₹ 790.00
2	[1642610] 2.8 Inch TFT LCD Non-Touch display module(SD card support)	85439000	₹ 431.360000	1.00	₹ 0.00	₹ 431.36	₹ 77.64 (18.0%)	₹ 509.00
3	[26300] AMS1117-3.3V, 1A, SOT-223 Voltage Regulator IC	90138010	₹ 45.690000	1.00	₹ 0.00	₹ 45.69	₹ 8.23 (18.0%)	₹ 54.00
4	[31514] A3144 Hall Effect Sensor Module	84715000	₹ 33.050000	1.00	₹ 0.00	₹ 33.05	₹ 5.95 (18.0%)	₹ 39.00
5	[std_shipping] STANDARD SHIPPING	996819	₹ 0.000000	1.00	₹ 0.00	₹ 0.00	₹ 0.00 (18.0%)	₹ 0.00
			Total:	6.000				

Item	Taxes	Amount
1	18% IGST (Sale)	₹ 212.42

Subtotal	₹ 1179.58
Taxes	₹ 212.42
Total	₹ 1,392.00

Amount in Words: ONE THOUSAND THREE HUNDRED NINETY-TWO INDIAN RUPEE
Payment terms: Immediate Payment

EtaPro Technologies Pvt Ltd

21-D1, 11/1, 1st Main Road
Peenya Industrial Area
Bangalore Karnataka 560058
India
Company ID :
U72900KA2016PTC098063
GSTIN 29AAECE4585F1ZE
LUT :
AD2904230007557

TAX INVOICE

Invoice Number	**: LCY2B324AD396030**	Place Of Supply	**: West Bengal (19)**
Invoice Date	**: 04-03-2024**	Transaction Id	**: N.A**
Due Date	**: 04-03-2024**	Ordered CUST ID	**: 1000021637**

Bill To

Abhirup Bhattacharyya
14, AC Banerjee Road
Lakshmi Narayan Apartment
Kolkata
700057 West Bengal
India
Account ID : 5000002610

Ship To

ATTN : Ritam Majumder
Salil Bose Nagar, Near 2 number Rail Gate
Barasat
West Bengal - 743248
India
+918017483866

#	Item & Description	Storage Location	Qty	Rate	Amount
1	Printed Circuit Board Fabrication SKU : LC-PCB-FABRICATION PID: 113294 Project Name: Ritam_PCB_design_WEATHR_STATION HSN: 85340000	-	5.00 pcs	319.60	1,598.00
2	Fabrication NRE charges SKU : LC-PCB-NRE SAC: 998739	-	1.00	0.00	0.00
3	Outward Shipping Charges SKU : LC-OUTWARD-SHIP SAC: 996812	-	1.00	0.00	0.00

Total In Words
Indian Rupee One Thousand Seven Hundred Ninety-One Only

Sub Total	1,598.00
Discount	(-) 80.00
IGST18 (18%)	273.24
Rounding	-0.24
Total	**₹1,791.00**

Product	SKU	HSN	Qty	Rate	Item Total
10nF 50V Multi Layered Ceramic Capacitor (MLCC) - X7R - SMD 1206 - 10%	KSTC1071	85322990	20	₹0.70	₹16.60
Smd Red Led 1206 Package	KSTL0401	8541	20	₹0.72	₹17.00
100nF 50V (104) Muiti Layered Ceramic Capacitor (MLCC) - SMD 1206	KSTC0753	8532	25	₹0.81	₹24.00
Resistor 330 Ohms 5% 1/4W SMD 1206	KSTR1062	85331000	40	₹0.28	₹13.20
10K Ohms 3296 Multiturn Trimpot Potentiometer	KSTR0974	8533	5	₹7.29	₹43.00
Resistor 1K Ohms 1% 1/4W SMD 1206	KSTR0870	85331000	40	₹0.30	₹14.00
Resistor 10K Ohms 1% 1/4W SMD 1206	KSTR1068	85331000	40	₹0.30	₹14.00
Resistor 2.2K Ohms 1% 1/8W SMD 0805	KSTR0296	853321	40	₹0.24	₹11.20
Resistor 4.7K Ohms 1% 1/4W SMD 1206	KSTR1064	85331000	40	₹0.25	₹12.00
LM2596ADJ Step Down Regulator - Adjustable Output - TO263-5	KSTI0173	85423100	8	₹16.95	₹160.00
22uF 25V Multi Layered Ceramic Capacitor (MLCC) - SMD 0805 - YAGEO	KSTC1406	8532	12	₹2.12	₹30.00
Inductor 47uH - 10x10x4mm - CDRH104R - SMD	KSTI1275	8504	10	₹11.40	₹134.50

roduct	SKU	HSN	Qty	Rate	Item Total

Subtotal	₹489.50
Shipping	₹141.60 via Express Shipping - Bluedart (Delivery within 1 to 4 days)
Total Taxable Value	₹534.83
Total	₹631.10 **(includes ₹96.27 18%** IGST)

TOTAL : 7965/-