

**Examples of Write-ups of the Exhibits**  
**Two Examples of Write-ups of the Exhibits Displayed in**  
**Earlier Exhibition are Given Below to Facilitate Students**  
**to Develop the Write-up of their Exhibit**  
**First Example of the Write-up**

**JAWAHAR NAVODAYA VIDYALAYA**

**IT Exhibit 2023-24**

NAME OF THEME: TECHNOLOGY AND TOYS  
 NAME OF SUB-THEME: ADVANCEMENT IN INFORMATION AND COMMUNICATION TECHNOLOGY  
 NAME OF EXHIBIT: TINYML IN ROBOTICS  
 NAME OF PARTICIPANT: AYAZ AKBAR, (CLASS XII)  
 NAME OF THE GUIDE: SREENIVASAN T A, PGT PHYSICS



**I. INTRODUCTION:**

Demonstrating the use of TinyML in the area of robotics, particularly in enhancing the user experience. TinyML is a compact form of machine learning, used to provide microcontrollers the tool of artificial intelligence. Embedded machine learning with the help of online platforms like Edge Impulse and allows creators to devise their own application with just a little or no knowledge on Machine learning.

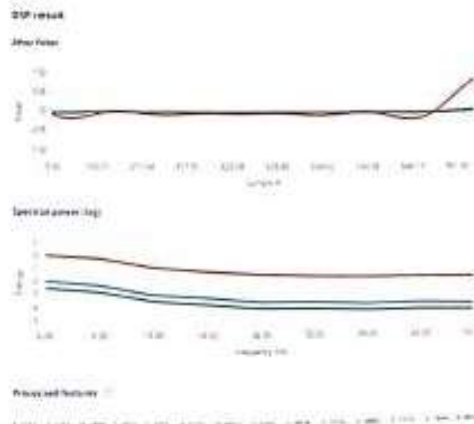
I have created a basic gesture recognition device using an MPU6050 accelerometer sensor and a Pi Pico RP2040. The model is trained to recognize left-right, up-down and idle motion and can be enhanced further by adding more gestures to it. The whole application is developed on the Pico's C/C++ sdk on VScode with MicroPython and the edge impulse platform for training the model.

**II. SCIENTIFIC PRINCIPLES INVOLVED:**

To develop this exhibit, C/C++ was used to implement the program into the AI using Edge Impulse. Game programs were created for a better understanding of the gesture recognition device using Python.

RP2040 is a MCU which has 133MHz dual ARM Cortex-M0+ cores / 264KB SRAM / 30 GPIOs / Extension programmable interfaces / 4 Channel ADC.

The MPU6050 is a MEMS accelerometer used for the Raspberry Pi and Arduino. It has a 6-axis sense with a temperature sensor on board. It is valued for its low power, simplicity, and surprising accuracy for such a low-cost sensor.



### III. MATERIALS USED:

- Raspberry Pi Pico RP2040 microcontroller
- MPU6050 Accelerometer and Gyroscope
- HC-05 Bluetooth Module
- Visual Studio Code
- Python 3.11
- Edge Impulse

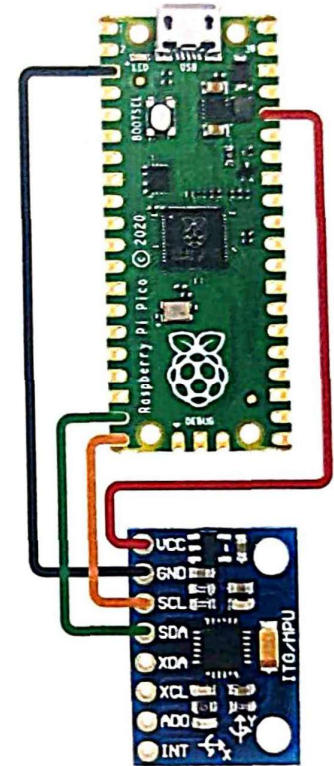
### IV. CONSTRUCTION AND WORKING OF THE EXHIBIT:

The 6-axis accelerometer gyroscope module senses orientation and angular rotation data through a complicated MEMS (micro electromagnetic systems) arrangement. It sends this data to the Raspberry Pi Pico through the bus using I2C communication protocol. The Raspberry Pi Pico inputs this information into a Machine Learning model that decides what gesture is being shown using a TinyML implementation by Edge Impulse.

This is the most technical part of the project. After deciding what the gesture is, the Pico sends the message through the serial USB cable, and also broadcasts it through Bluetooth using the HC-05 Bluetooth module.

The most challenging part of this project was deploying TinyML in Pico. C++ was used to interface Edge Impulse with the Pico and thus collect Training data. Each gesture was then incorporated into the AI with a training time of 10 min each. The model was then built selecting the options for Neural Network classifiers, Anomaly detection and Spectral analysis. The finished model was downloaded, and then deployed into the Pico as a finished program.

The software part of our project integrates this message received into various games like Dino, Snake and Flappy, letting people have an increased user-machine interaction.

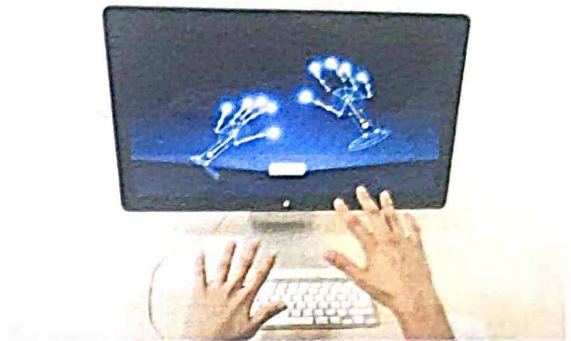


### V. APPLICATIONS:

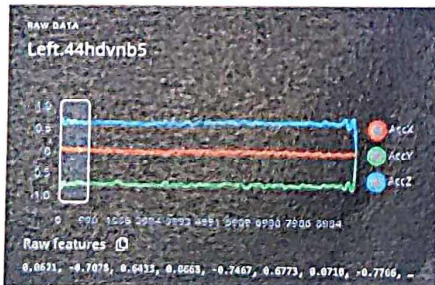
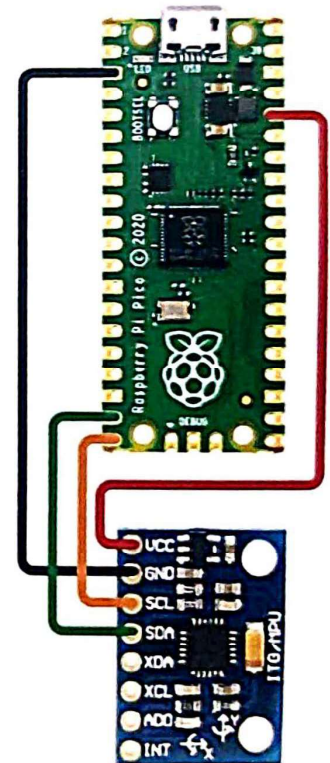
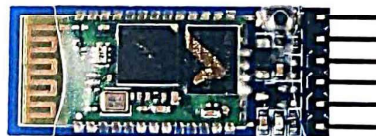
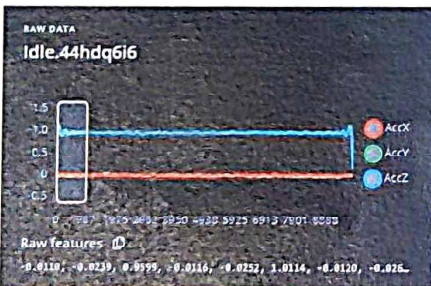
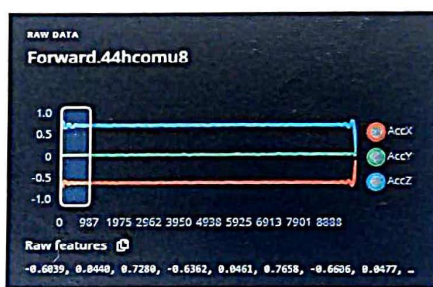
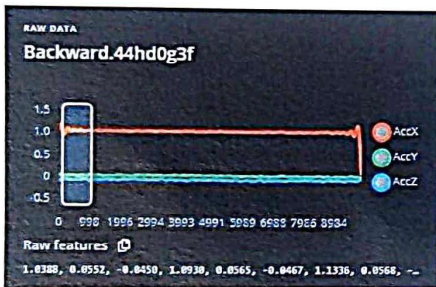
- Program that can run traffic signal by checking traffic in each lane of the road.
- By implementing ML we can make robots that can design what to do next when lost from its controlling range.
- Robots can be deployed to reach certain places to where humans cannot access.  
E.g.: Earthquake sites, flooded area, etc.
- A wheelchair controller by gesture recognition

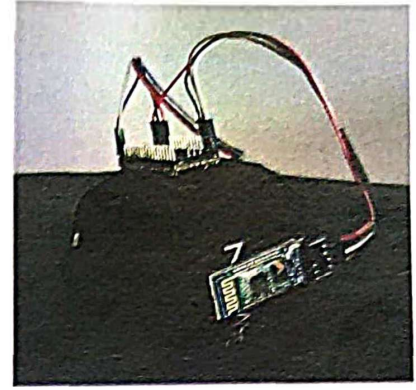
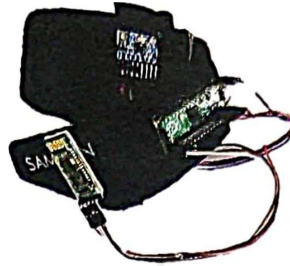


- Air conditioners that can check temperature and at rise or fall of temperature gets adjusted to the fixed temperature.
- Program that can order any grocery or items whenever required.
- Self-Driving cars that can detect a face expression of people nearby and predict next outcome.
- A virtual personal assistant
- Face Recognition to find people who is ringing the doorbell.



## VI. ILLUSTRATIONS:





## VII. RESULTS:

I have reached the conclusion that deploying TinyML to enhance the human machine interface was more than successful. I strongly believe that the projects paves the way for the most top grossing revolutionary industrial project India has ever seen both in commerciality and research.

## VIII. REFERENCES:

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Edge Impulse Motion Recognition: <https://docs.edgeimpulse.com/docs/tutorials/continuous-motion-recognition>

## Second Example of the Write-up

**Name of the theme:** Technology and Toys

**Name of the Sub theme:** Health and Cleanliness

**Name of the Exhibit:** Air Purifier

**Name of the Participant:** Tejas Verma

**Name of the Guide/Teacher:** Arushi Saini

### AIM OF PROJECT

\* To study uses, working, principle of a transformer and using a step up transformer to make working mode of particular chimney.

\* Objectives to be studied.

1. Principles of a transformer
2. Working of a transformer
3. Types of transformer
4. Working of a precipitator chimney.
5. How to make precipitator chimney.
6. How to make precipitator chimney
7. Uses of precipitator chimney.

### INTRODUCTION

- \* A transformer is an electrical device which is used to convert between high voltage current and low voltage current it can be a step up 'on' a step down.
- \* A transformer has many application like stepping voltage up for household grid.
- \* A precipitator chimney has a pass way fitted with a high voltage A>C supply (100-400kv) to ionize impure gases and lets pass pure gases.
- \* Precipitator chimneys can be used in factories, exhaust systems, or as domestic air purifies.

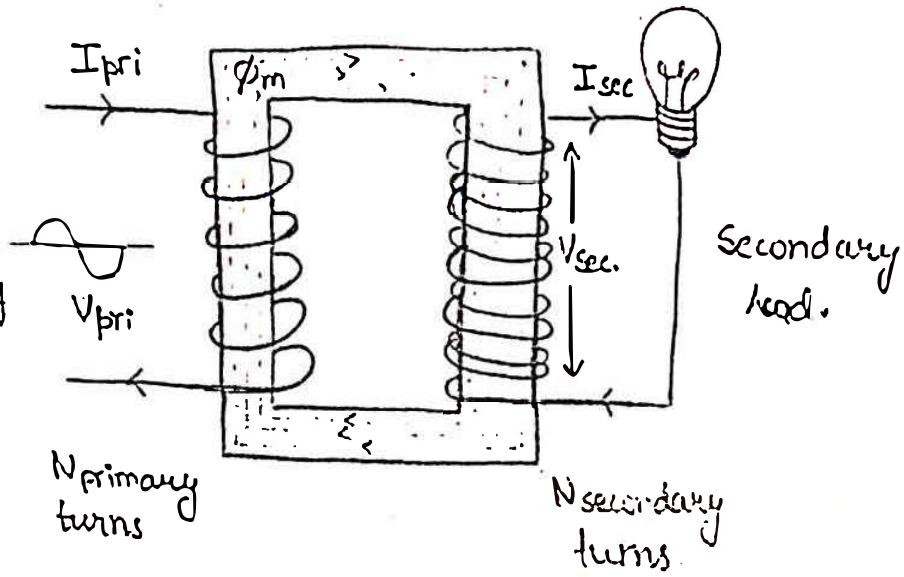
### THEORY

- \* Principal of transformer: IT works faraday's law of mutual induction. Faradays's Law of E.M.I states that , when a change takes place in magnetic flux which is linked with a circuit, an electromotive current will be induced in the circuit.
- \* Working of transformer : A transformer is made from a core that has common input and output sides. Two inductive windings are embedded in this core which is electrically insulated from each other. The input coil in which electrical voltage is fed is known as primary winding. The output coil from which the electrical voltage is drawn is called the secondary winding.
- \* When an input alternating voltage  $V_1$  is applied across the v primary coil of the transformer, it generates an alternating electromotive force emfe is produced in the core. According to faraday's Law of E.M.I

$$e_1 = -N_1 \frac{d\phi}{dt} V$$



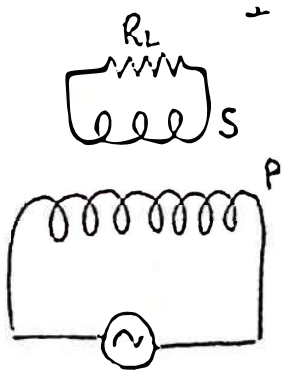
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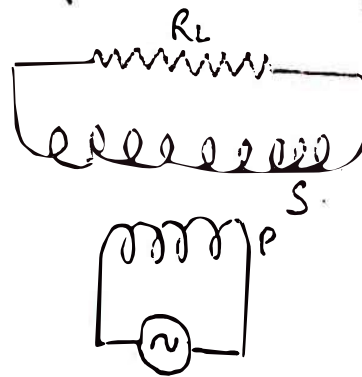
$N_1 < N_2 \rightarrow$  Step-up transformer

$N_1 > N_2 \rightarrow$  Step-down transformer.

W



Step-down transformer



Step-up transformer.

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An emf runs through the primary coil.

Where,

\* EMF is 1<sup>st</sup> order time derivative of electromagnetic flux.

\*  $e_1$  = electromotive force.

\*  $N_1$  = Number of turns in primary coil.

The electromagnetic flux emf  $e_1$  is indirectly equal and opposite to the input alternating voltage ( $v_1$ ).

If we assume that the leakage flux is negligible and there are no losses in the transformer.

Due to Faraday's Law of electromagnetic induction, an electromotive force  $e_2$  is produced in the secondary coil.

An electromotive force  $e_2$  runs through the secondary coil.

$$e_2 = -N_2 \frac{d\phi}{dt}$$

Where,

\* EMF is 1<sup>st</sup> order time derivative of electromagnetic flux.

\*  $e_2$  = Electromotive force.

\*  $N_2$  = no. of coils turns in secondary coil.

### TYPES OF TRANSFORMER

#### 1. Step up transformer

$$\text{If } N_1 < N_2$$

$$e_1 < e_2$$

A step up transformer is defined as a device that receives an electrical alternating voltage and converts it into a higher voltage. It is the transformer that has more turns in the secondary winding compared to the primary coil.

#### 2. Step-down transformer

$$\text{If } N_1 > N_2$$

$$e_1 > e_2$$

A step down transformer is defined as a device that receives an electrical signal of A.C and converts it into a lower voltage. It is the transformer that has more turns in the primary winding as compared to the secondary coil.

#### \* Uses of transformer

Transformer has several day-to-day uses like:

\* wall transformer (chargers)

\* power stations

\* Automatic and industrial processing controls.

\* Lightning systems.

\* Small appliances.

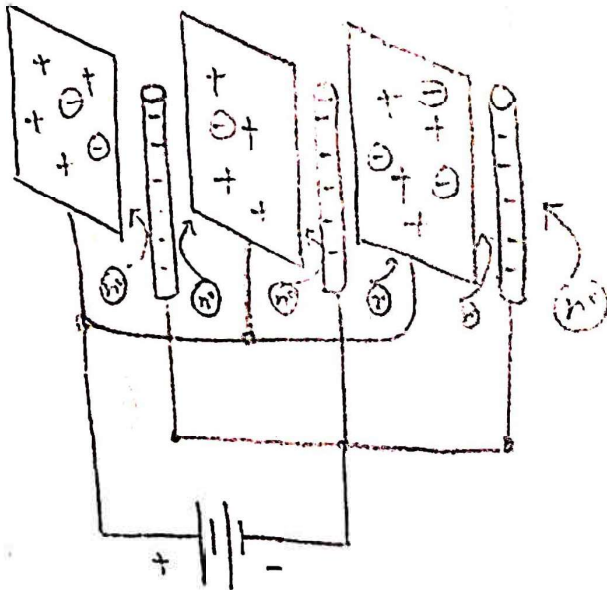
\*Precipitator chimneys

\*grid transformer etc.

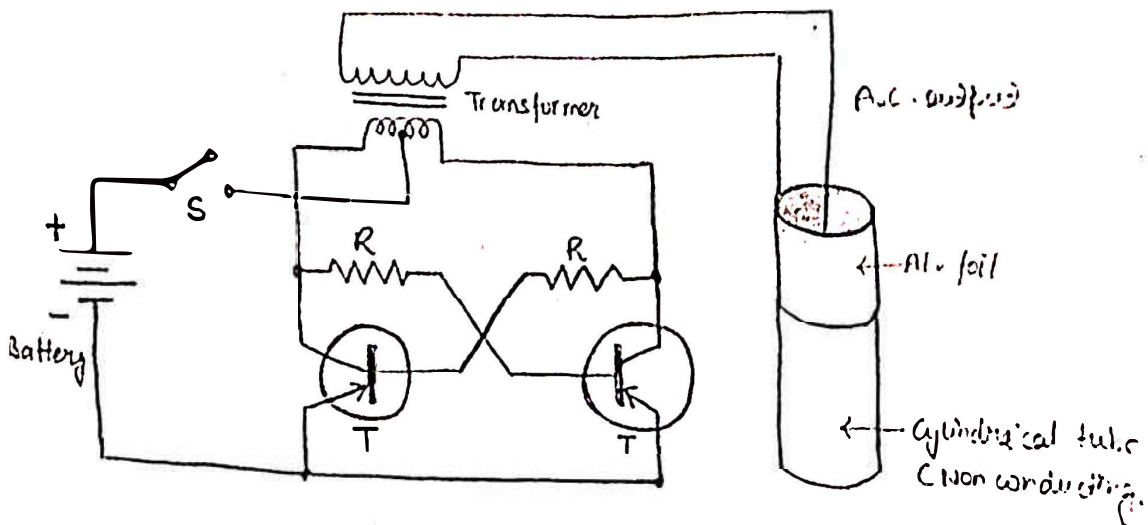
\* **WORKING OF A PRECIPITATOR CHIMNEY**

A precipitator chimney or electrostatic precipitator is a type of filter that uses of high voltage supply to ionize pollutants in air or exhaust and remove them from exhaust fumes.

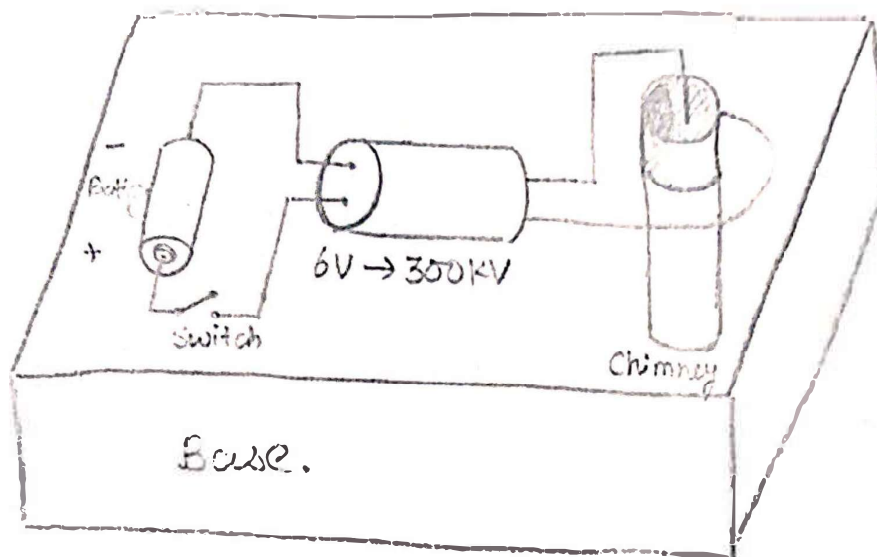
Unburnt carbon particles of smoke are ionised when they get close to a high voltage pole, and stick to the walls of chimney



→ Collector plate  
→ Ionizer  
→ unburnt particles  
→ collected ionised particles







### How to make a precipitator chimney.

**Apparatus:** A high voltage supply or a step up transformer(100-300kv), A base, A cylindrical tube, A switch , battery , foil paper and connecting wire, a transistor.

**Theory:** When unburnt –C particles get in vicinity of high voltage pole they get ionize and stick to the other pole due columbic force of attraction.

**Procedure:** 1. Take one end of output of transformer and connective it to a strip of aluminium foil.

2. Suspended the other end of output in the cylinder tube.
3. Paste the aluminium foil connected to transformer on inside wall of cylinder tube.
4. Take a battery of sufficient power and connect it to tha transformer /power supply input and also connect a switch in between to open and close the connection.
5. Fix everything on a base as shown in the figure.
6. Place a smoke source like incence stick on the base, put the chimney over it.
7. Observe that happens when you open/close the switch.

### OBSERVATION

When switch is open, smoke escapes out from upper end of chimney, but when switch is nclosed smoke stops coming ot.

Uses of precipitator chimney

Despite being a simple electrical device, a precipitator chimney has an effectiveness of removing about 99% of particular matter from exhaust.

Electrostatic precipitator are used in:

- \*industrial plants.
- \*exhuahst systems.
- \*air purifiers
- \*respiratory health equipments.

## **SOURCE OF ERRORS**

- \*connections may be lose.
- \*supply may not be high voltage
- \*battery may be drained.
- \*suspended wire and collector plate may be touched.

## **PRECAUTIONS**

- \*Keep high voltage supply away from body.
- \*Don't touch wire directly when switch is closed.
- \*testing must be done under supervision.
- \*use of non-conducting hand gloves while reduce chances of getting shocked.
- \*suspended wire (ionize) and collector plate must not touch.

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MTG fingertips 11<sup>th</sup>,12<sup>th</sup>