Final Year Project Showcase Batch 2020
Year 2024

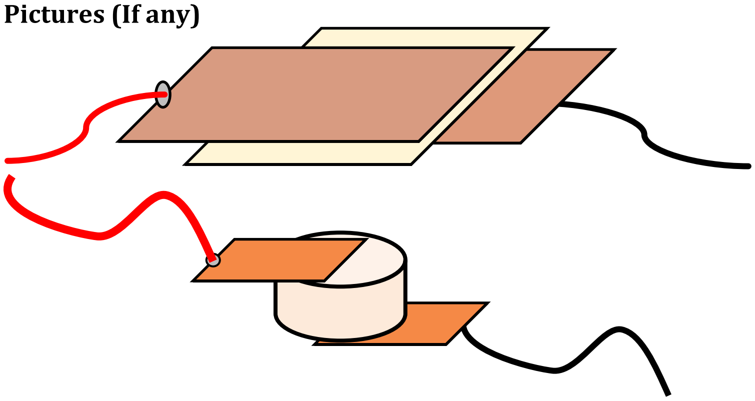
Department: Materials Engineering Programme: Bachelors in Engineering	
1	**Project Title** Design and Development of Piezoelectric Composite Materials for Flexible Sensor Application.
2	**Project Idea** To establish piezoelectric sensor with cost effective and better results.
3	**Process** Material Selection: The project uses piezoelectric fillers (Barium Strontium Titanate and Potassium Sodium Niobate) combined with polymers (PVA and PVDF). Fabrication Methods: Solution casting and hot pressing are employed to create composite films with uniform filler distribution, ensuring high-quality sensor performance. Testing Protocols: The project includes rigorous testing such as d_{33}, LCR meter and oscilloscope analysis to assess the dielectric and piezoelectric properties of the composite films, ensuring the sensor's reliability and efficiency.
4	**Outcome** High-Quality Sensors: The project successfully produces flexible piezoelectric sensors with superior piezoelectric performance. Cost-Effective Production: The process is optimized for scalability, making it feasible for commercial production without significant cost increases. Environmental Impact: The use of lead-free materials like KNN makes the sensors environmentally friendly, aligning with sustainability goals.
5	**Evidence (Theoretical Basis)** The project focuses on designing and developing piezoelectric composite materials for flexible and wearable sensor applications. By optimizing material selection, fabrication processes, and rigorous testing, the project produces high-performance, cost-effective sensors suitable for various applications, including healthcare, environmental monitoring, and smart textiles.
6	**Impact on Sustainability of Urban Regions or SDG-11 "Sustainable Cities and Communities"** Real-Time Monitoring: The flexible sensors enable integration into urban infrastructure for monitoring environmental and structural conditions. Resource Efficiency: Utilizing sustainable materials like Polyvinyl Alcohol (PVA) and Polyvinylidene Fluoride (PVDF) reduces energy consumption during production. Public Health Applications: The sensors can enhance health monitoring capabilities in urban settings. Smart City Integration: They support smart technologies that optimize energy use and waste management. Innovative Material Use: The project promotes advanced materials, contributing to sustainable design practices.

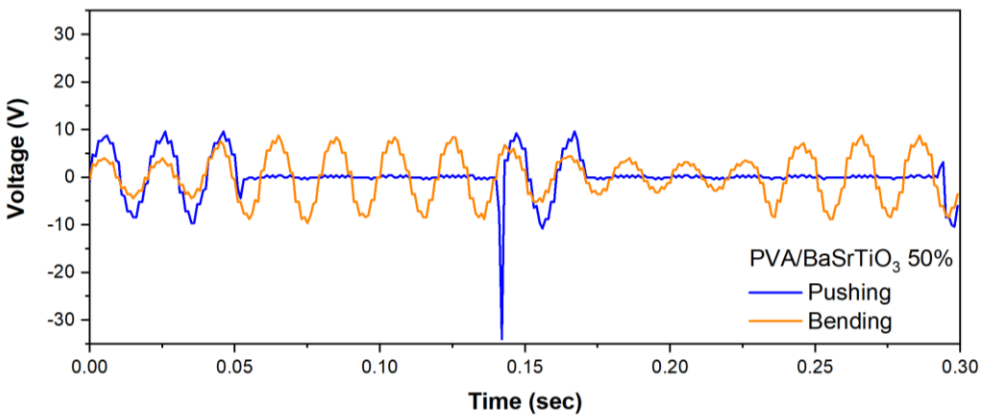
7	**Competitive Advantage or Unique Selling Proposition** (Cost Reduction, Process improvement, Attainment of any SDG (Sustainable Development Goal), increase of market share or capturing new market or having superior performance over a competitor. In summary, any striking aspect of the project that compels the industry to invest in FYP or purchase it. Some detailed description is required in terms of how, why when what. You can select one or more from the following dropdown and delete the rest of them). Please keep relevant options, delete the rest of them, and correct the sequence
a	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region) **SDG-3: Good Health and Well-Being** Piezoelectric composites are used in wearable sensors for tracking vital signs like heart rate, body movements, improving diagnostics and real-time health monitoring. In regions like Pakistan, where healthcare access is limited, these affordable sensors enable early diagnosis and continuous monitoring, benefiting remote areas. **SDG-7: Affordable and Clean Energy** Piezoelectric materials convert mechanical energy into electrical energy, creating self-powered, energy-efficient devices. Energy-efficient technologies are crucial for regions facing energy shortages, reducing dependency on external power and promoting clean energy. **SDG-9: Industry, Innovation, and Infrastructure** The project advances sensor technology with new piezoelectric composites, benefiting industries like healthcare and electronics. Fostering innovation boosts local industry, drives economic growth, and enhances infrastructure, contributing to global advancements.
b	**Environmental Aspect** The project emphasizes the use of lead-free ceramics, such as Potassium Sodium Niobate (KNN), which are environmentally friendly compared to traditional lead-based piezoelectric materials. It also utilized PVA which biodegradable over time which also leads to sustainability. This aligns with global efforts to reduce environmental pollution and ensure sustainability. The project's alignment with Sustainable Development Goals (SDGs) reflects its focus on environmental monitoring and resource management.
c	**Cost Reduction of Existing Product** The project aims to enhance sensor performance while maintaining cost-effectiveness. The use of PVA, which are cost-effective and readily available, contributes to the overall reduction in manufacturing costs. The development of piezoelectric materials that are easier and cheaper to fabricate can lead to more affordable sensor technologies, making them accessible for broader applications.
d	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Project.** The project enhances the fabrication of piezoelectric composite films by optimizing processes like mixing, casting, and drying to ensure uniform filler distribution and minimize defects. Utilizing solution casting and hot pressing methods improves film quality and piezoelectric performance. Rigorous testing, such as d_{33}, LCR and oscilloscope analysis, ensures superior product quality and reliability. Additionally, the process is designed for efficiency, scalability, and cost-effectiveness, with careful material selection (PVA and PVDF) further improving

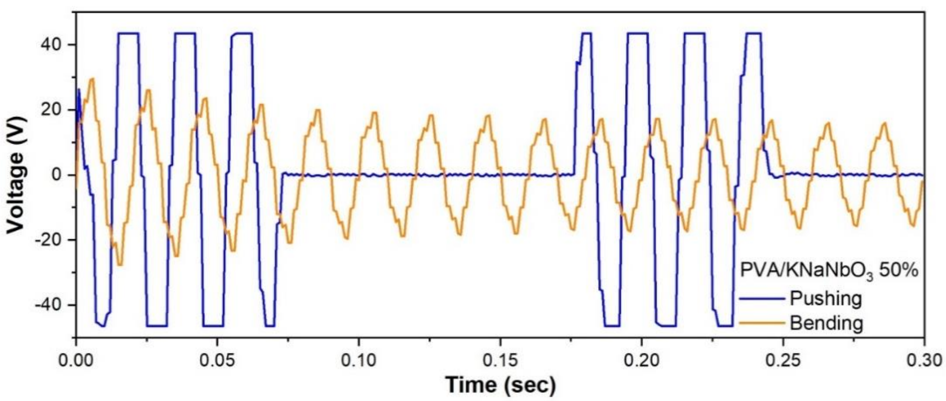
	sensor efficiency. These improvements make the project viable for environmental sustainability, cost reduction, and market expansion.
e	**Expanding of Market share** By developing flexible and wearable sensors with enhanced properties (e.g., sensitivity, flexibility, and biocompatibility), the project taps into rapidly growing markets such as healthcare and wearable technology. The innovation in sensor design and materials can help capture new markets, particularly in areas like biomedical technology, environmental monitoring, and smart cities, where advanced, flexible sensors are increasingly in demand.
f	**Capture New Market** Healthcare and Wearables: The flexible sensors are ideal for wearable health monitoring devices, capturing a growing market in personal healthcare and fitness. Environmental Monitoring: The sensors can be used in smart cities and environmental monitoring, expanding market opportunities in these sectors.
g	**Any Other Aspect** Sustainability: The project aligns with several United Nations Sustainable Development Goals (SDGs), particularly in promoting good health, industry innovation, and climate action. Scalability: The process is designed to be scalable, allowing for easy transition from lab-scale production to commercial manufacturing. Innovation: By focusing on lead-free piezoelectric materials, the project addresses environmental concerns while pushing the boundaries of sensor technology.
8	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service Healthcare Providers: Hospitals and clinics utilize these sensors for monitoring patients' vital signs and health conditions through wearable devices. Wearable Technology Companies: Manufacturers of fitness trackers and smartwatches integrate these sensors to enhance tracking capabilities for health and physical activity. Construction and Civil Engineering: Structural engineers use these sensors for real-time monitoring of infrastructure health, ensuring safety and integrity. Sports and Fitness Enthusiasts: Individuals interested in advanced performance tracking can benefit from wearable devices equipped with these sensors.

9	**Team Members** (Names along with email address	Umm e Aiman (azizaiman969@gmail.com) Fouzia Haider (fouziahaider245@gmail.com) Uroosa Siddiqui (uroosasiddiquiadamjee26@gmail.com)
10	**Supervisor Name** (along with email address)	Prof. Dr. Fayaz Hussain (engrfayazned@gmail.com)

Pictures (If any)




Voltage (V)
Time (sec)
PVA/BaSrTiO3 50%
Pushing
Bending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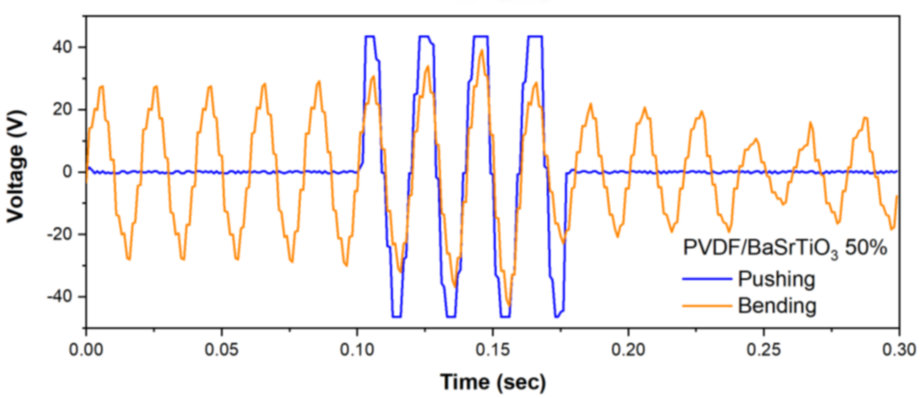
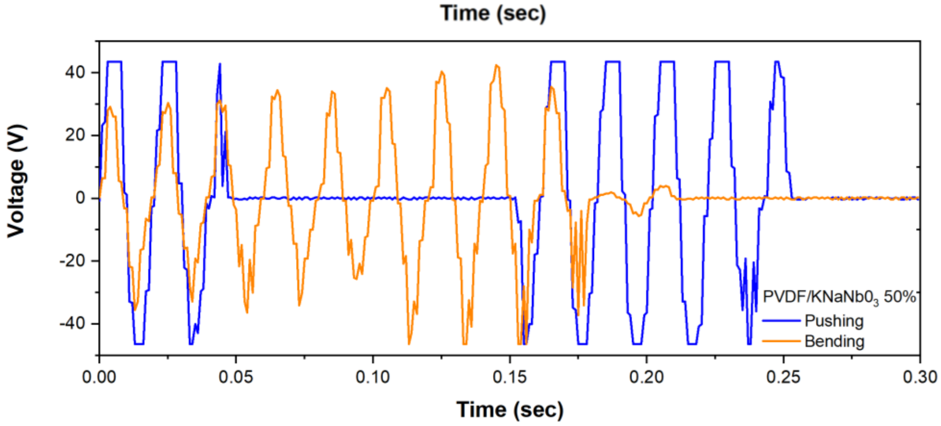

Voltage (V)
Time (sec)
PVDF/BaSrTiO3 50%
Pushing
Bending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