Final Year Project Showcase Batch-2019
Year 2023

Department: Electronic Engineering Programme: Bachelors of Engineering	
1	**Project Idea** Many harmful microorganism have coexisted with us throughout history and have played theirpart for harming humans. As did the Covid-19 it struck the whole world and concept of disinfection rise in the world. Disinfection is not a new concept but the methods that have been utilized disinfecting human belongings fail due to their shortcomings which causes harmful bacteria's and viruses to remain alive which may cause serious health hazard. To overcome the issue we will utilize the ultra-violet technology, ultra-violet is type of naturally present electromagnetic radiation with wavelength shorter than visible light but longer than x-rays. There are three types of ultra-violet radiation namely UVA, UVB, UVC. Ultra-violet lights with wavelength less than 290nm are considered to have germicidal properties meaning they can kill germs. Ultra-violet C (UV-C) having wavelength between 200nm to 280nm is a perfect disinfector for harmful microorganism. We will utilize UV-C light composed of fluorescent lamp tube with no phosphor coating, composed of fused quartz. UVC lights can make any items bacteria free. UVC light produces electromagnetic energy that can destroy the ability of microorganisms to reproduce and by causing photo-chemical reactions in nucleic acids RNA. UVC light technology is a radiation method that makes use of a specific wavelength of ultraviolet light to neutralize microorganisms. UVC lights have been used to disinfect liquids, air, and the surfaces of solids, including foods. UVC lights are Environmentally-friendly, UVC lights are quite cost effective, UVC lights have the capability to kills rapidly, Also the Microbial cells cannot develop resistance to this technology. The project uses the help of A.I based image recognition and Iot based database to understand the object being disinfected and storing the data to know exactly how much time should be taken for disinfecting the object this gives it the ability to smartly identify the object and remember it .In this project we are going to make a smart UV-C Light disinfection tunnel to disinfect the objects/belongings carried by humans for example; cell phones, wallets bags, etc.
2	**Process** We will begin with Hardware and Software implementation, and research to insure the hardware and software compatibility with each other. We will design a structure that contains the UV-C lights attached to achieve almost 360-degree angles inside the tunnel.We will deploy Raspberry pi for many purpose firstly for image processing of the object while utilizing the help of pir motion sensor, ultrasonic sensor and weight sensor to successfully know the dimensions of the object and recognition of the object and make a database simultaneously. The Raspberry pi will also control the DC motors which will move the conveyor belt, by image recognition and object dimension it would decide the time for the object to remain in the tunnel also show the data on screen and on mobile, the maximum time the object will be in tunnel is 20 seconds. Lastly, the sensors at the end of conveyor will detect the object when it leaves tunnel. The screen on the machine will provide real time data of the object and ultraviolet-c light while giving the time and percentage left for the object to disinfect fully.
3	**Outcome** Many harmful microorganism have coexisted with us throughout history and have played

	their part for harming humans. As did the Covid-19 it struck the whole world and concept of disinfection rise in the world. Disinfection is not a new concept but the methods that have been utilized disinfecting human belongings fail due to their shortcomings which causes harmful bacteria's and viruses to remain alive which may cause serious health hazard. To overcome the issue we will utilize the ultra-violet technology, ultra-violet is type of naturally present electromagnetic radiation with wavelength shorter than visible light but longer than x-rays. There are three types of ultra-violet radiation namely UVA, UVB, UVC. Ultra-violet lights with wavelength less than 290nm are considered to have germicidal properties meaning they can kill germs. Ultra-violet C (UV-C) having wavelength between 200nm to 280nm is a perfect disinfector for harmful microorganism. We will utilize UV-C light composed of fluorescent lamp tube with no phosphor coating, composed of fused quartz. UVC lights can make any items bacteria free. UVC light produces electromagnetic energy that can destroy the ability of microorganisms to reproduce and by causing photo-chemical reactions in nucleic acids RNA. UVC light technology is a radiation method that makes use of a specific wavelength of ultraviolet light to neutralize microorganisms. UVC lights have been used to disinfect liquids, air, and the surfaces of solids, including foods. UVC lights are Environmentally-friendly, UVC lights are quite cost effective, UVC lights have the capability to kills rapidly, Also the Microbial cells cannot develop resistance to this technology. The project uses the help of A.I based image recognition and Iot based database to understand the object being disinfected and storing the data to know exactly how much time should be taken for disinfecting the object this gives it the ability to smartly identify the object and remember it .In this project we are going to make a smart UV-C Light disinfection tunnel to disinfect the objects/belongings carried by humans for example; cell phones, wallets bags, etc.
4	**Evidence (Theoretical Basis)** The research report highlights the efficacy and benefits of using UV-C light for disinfection in various industries, with a particular focus on its application in the food industry. The Smart UV-C Disinfection Tunnel, equipped with advanced technologies like Raspberry Pi 4, Arduino Uno, and ultrasonic sensors, offers a compact, automated, and efficient solution for disinfecting food products and surfaces. The system's ability to precisely control the disinfection process ensures maximum effectiveness while minimizing the required time. Furthermore, the use of UV-C light ensures a safe and environmentally friendly approach to disinfection, making it a suitable option for small and medium-sized businesses. Additionally, the report suggests that the UV-C technology can be extended to benefit other industries, including healthcare, pharmaceutical, hospitality, transportation, and retail, where effective disinfection is crucial for maintaining a safe and hygienic environment. Overall, the research highlights the potential of UV-C light as a highly effective and versatile method of disinfection, with the Smart UV-C Disinfection Tunnel presenting a practical and sustainable solution for ensuring food safety and reducing the risk of contamination across various sectors.
5	**Competitive Advantage or Unique Selling Proposition** The UV-C disinfection of devices can be used on daily or household items, such as phones, keys, or packaging materials ✓ In today's time of various possible futures in which pandemics like COVID-19 are more ✓ commonplace. ✓ Smartly recognize the object and set the disinfection time accordingly while making a

	✓ database of it. ✓ Remote access to the data on the machine. ✓ Keeping the object safe while disinfecting the object using environmental friendly uv-c light. ✓ UV-C disinfection of milk powder bags or any food item Personal belongings can also be disinfected. ✓ UVC Light Disinfection is Safe for any kind of objects. ✓ Personal belongings can also be disinfected. ✓ Proactive health protection for patients and medical staff with UV-C air and surface ✓ disinfection. ✓ UV-C light treatment is an effective, chemical-free method of infection prevention. ✓ It's shown to reduce the levels of bacteria and funguses in the air, and in some studies has ✓ been shown to reduce the number of overall infections in hospitals. ✓ Proactive health protection for patients and medical staff with UV-C air and surface disinfection. ✓ Provides safe, medical-hygienic in: 1)Medical practices 2)Hospitals 3)Pharmacies 4)Retirement and nursing homes, assisted living 5)Physiotherapy
a	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region) UVC (Ultra Violet-C) technology has various applications and importance in Pakistan, as it does worldwide. Here are some key areas where UVC technology is significant in Pakistan: **Water Disinfection:** Pakistan faces significant challenges in providing clean and safe drinking water to its population. UVC technology is used to disinfect water at the municipal level, in water treatment plants, and even in household water purification devices. This helps reduce the spread of waterborne diseases and ensures access to safe drinking water. **Healthcare:** UVC technology is used in healthcare settings for the disinfection of surfaces, air, and medical equipment. Especially in the context of the COVID-19 pandemic, UVC devices have been used to disinfect hospital rooms and equipment to reduce the risk of infection transmission. **Air Purification:** Air quality in Pakistan's major cities, such as Lahore and Karachi, can be poor due to pollution. UVC air purifiers can help in removing harmful pathogens, including bacteria and viruses, from indoor air, which is particularly relevant for healthcare facilities, offices, and homes. **Food Industry:** In the food processing and packaging industry, UVC technology is used to disinfect surfaces and packaging materials, reducing the risk of foodborne illnesses and ensuring food safety. **Wastewater Treatment:** UVC technology can also be applied in wastewater treatment plants to disinfect effluent water before it is released into the environment. This helps in minimizing water pollution and protecting aquatic ecosystems. **Research and Education:** UVC technology is vital in scientific research and laboratories for

	various applications, including DNA and RNA analysis. In educational institutions, it supports research and experiments related to UV radiation. **Public Health:** UVC technology plays a role in public health campaigns and initiatives aimed at reducing the transmission of diseases. It can be used to disinfect public spaces, transportation, and high-touch surfaces. **Agriculture:** In agriculture, UVC technology can be applied for crop protection, pest control, and pathogen elimination in greenhouses and controlled environments, contributing to food security. **Industrial Applications:** UVC technology is used in various industrial settings for surface disinfection, quality control, and sterilization processes. **Energy Efficiency:** UVC technology can enhance the energy efficiency of HVAC (Heating, Ventilation, and Air Conditioning) systems by keeping coils and ducts free from microbial growth, which can reduce energy consumption. In Pakistan, like in many other countries, the importance of UVC technology has been highlighted by the COVID-19 pandemic. Its applications in healthcare, air purification, and surface disinfection have become especially relevant. However, the technology has a broader range of uses that contribute to improving public health, environmental sustainability, and overall quality of life.
b	**Any Environmental Aspect** (e.g. carbon reduction, energy-efficient, etc.) **Positive Environmental Aspects:** **Reduced Chemical Use:** UV-C technology is often used as an alternative to chemical disinfection methods, such as chlorine or ozone. By replacing these chemicals, UV-C reduces the release of harmful substances into the environment and minimizes the risk of chemical contamination in water and air. **Energy Efficiency:** UV-C systems are generally energy-efficient and have a lower carbon footprint compared to some other disinfection methods. They require less energy to operate, especially when compared to high-temperature processes like pasteurization or autoclaving. **Water Conservation:** In water treatment and wastewater treatment applications, UV-C helps conserve water by ensuring that it can be safely reused or released back into the environment after disinfection without posing a threat to aquatic ecosystems. **Reduction in Greenhouse Gas Emissions**: By eliminating the need for certain chemical treatments and reducing energy consumption, UV-C technology can indirectly contribute to the reduction of greenhouse gas emissions associated with chemical production and energy generation. **Safe for Non-Target Organisms:** UV-C radiation is generally selective in its disinfection action, targeting microorganisms like bacteria and viruses. It does not harm non-target organisms or alter the chemical composition of water, which is essential for preserving ecosystems.

	Environmental Concerns: **Safety and Ozone Depletion:** Some UV-C lamps used in older systems may emit small amounts of ozone as a byproduct, which can contribute to ozone depletion in the atmosphere. However, modern UV-C systems are designed to minimize ozone production, and regulations are in place to limit emissions. **Waste Disposal:** The disposal of used UV-C lamps and equipment can pose environmental concerns if not handled properly. These lamps often contain mercury, a toxic element. Proper recycling and disposal procedures are necessary to prevent mercury contamination. **Energy Consumption:** While UV-C systems are generally energy-efficient, their environmental impact can still be influenced by the energy source used for operation. If the energy source is derived from fossil fuels, there may be associated greenhouse gas emissions. **Manufacturing and Materials:** The production of UV-C lamps and equipment involves the extraction of raw materials and energy consumption during manufacturing. Efforts to make these processes more environmentally friendly, such as using recycled materials and reducing energy use, can mitigate these concerns.
c	**Cost Reduction of Existing Product** The FYP project aims to implement a Smart UVC Disinfection Tunnel for food and pharmaceutical companies to achieve cost reduction of existing products through the following strategies: 1. **Efficiency Improvement:** The Smart UVC Disinfection Tunnel streamlines the disinfection process, reducing the time and labor required for manual disinfection, thus cutting operational costs. 2. **Resource Optimization:** By utilizing UVC technology, the project reduces the need for chemical disinfectants and minimizes waste disposal costs associated with traditional cleaning methods. 3. **Energy Efficiency:** Implementing energy-efficient UVC lamps and smart controls ensures lower energy consumption, contributing to reduced operational expenses. 4. **Maintenance Cost Reduction:** The system's smart monitoring and predictive maintenance capabilities help prevent breakdowns and reduce repair costs. 5. **Quality Control:** Enhanced disinfection processes can reduce the risk of contamination, spoilage, and product loss, contributing to cost savings in the long run. Overall, the Smart UVC Disinfection Tunnel project aims to provide a cost-effective and sustainable solution for food and pharmaceutical companies, leading to significant cost reductions in their existing product disinfection processes.
d	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** (e.g. What is the issue is current process and what improvement you suggests) ✓ Integration with IoT and Data Analytics ✓ Predictive Maintenance and Self-diagnosis

	✓ Smart User Interface and Reporting ✓ Integration with External Systems ✓ Adaptive Disinfection Parameters
e	**Expanding of Market share** (e.g. how it expand and what is the problem with the current market The FYP project involves the development of a "Smart UVC Disinfection Tunnel" tailored for food and pharmaceutical companies. The primary aim is to rapidly expand market share by addressing critical issues prevalent in the current market. **Problem with the Current Market:** 1. **Inefficiency:** Existing disinfection methods in food and pharmaceutical industries are often time-consuming and labor-intensive, leading to operational inefficiencies. 2. **Limited Automation:** Current solutions lack automation and real-time monitoring, resulting in human errors and inconsistency in disinfection processes. 3. **Safety Concerns:** Traditional disinfection methods may involve the use of chemicals that can pose health and safety risks to workers and potentially contaminate products. 4. **Compliance Challenges:** Stringent hygiene and sterilization standards make it challenging for companies to meet regulatory requirements consistently. **How it Expands Market Share:** 1. **Automation and IoT Integration:** The Smart UVC Disinfection Tunnel employs automation and IoT technology to ensure precise and consistent disinfection. It can be monitored remotely, reducing the need for on-site personnel. 2. **UVC Sterilization:** Utilizing UVC light, the tunnel offers a chemical-free and environmentally friendly disinfection process, ensuring product safety and compliance with industry regulations. 3. **Shortened Process Time:** By significantly reducing disinfection time, the solution boosts productivity, allowing companies to process more products in less time. 4**. Customization:** The system can be tailored to meet the specific needs of food and pharmaceutical companies, ensuring adaptability to various production lines. 5. **Data Analytics:** Incorporating data analytics, the system provides valuable insights into disinfection effectiveness, helping companies fine-tune their processes for optimal results. 6. **Cost-Efficiency**: Reduced labor costs and increased efficiency make this solution cost-effective for companies, contributing to its rapid adoption. 7. **Market Education:** An essential part of expansion is educating the market about the benefits of this innovative solution through marketing campaigns and industry partnerships. In summary, the Smart UVC Disinfection Tunnel aims to capture a significant share of the market by addressing existing inefficiencies and safety concerns, offering automation, customization, and cost-effectiveness, ultimately providing a modern and reliable solution

	for food and pharmaceutical companies.
f	**Capture New Market** (e.g. Niche market or unaddressed segment) The smart UVC disinfection tunnel for food and pharmaceutical companies can capture a new market by targeting niche segments such as small-scale food producers or specialized pharmaceutical manufacturers who require highly controlled and efficient disinfection processes. This innovative technology can cater to their specific needs, ensuring product safety and compliance with stringent regulations. By offering a tailored solution for these unaddressed segments, the project can penetrate new markets and establish itself as a valuable asset in the industry.
g	**Any Other Aspect** The Smart UVC Disinfection Tunnel for food and pharmaceutical companies presents several other important aspects: 1. **Safety Measures**: Ensuring the safety of personnel and products is paramount. The tunnel should incorporate motion sensors or safety interlocks to deactivate the UVC lights when someone enters the tunnel to prevent any harm to individuals. 2. **UVC Dosage Control**: Implement a precise control system to monitor and adjust the dosage of UVC light exposure. This ensures effective disinfection without damaging sensitive products or compromising their quality. 3. **Data Logging and Monitoring:** Include a data logging system that records disinfection cycles, UVC intensity, and usage statistics. This data can be valuable for quality control and regulatory compliance. 4. **Remote Management:** Consider enabling remote management and monitoring capabilities, allowing operators to control the tunnel's functions, receive alerts, and track its performance from a distance. 5. **Compliance with Regulations**: Ensure that the design and operation of the tunnel comply with relevant safety and regulatory standards for both food and pharmaceutical industries, such as FDA regulations. 6. **Integration with Workflow:** Make sure the tunnel integrates seamlessly into the existing workflow of food and pharmaceutical companies, minimizing disruption and maximizing efficiency. 7. **Maintenance and Servicing:** Develop a maintenance plan to keep the UVC system running efficiently, including regular lamp replacement and system checks to guarantee consistent disinfection. 8. **Cost-Benefit Analysis:** Conduct a cost-benefit analysis to demonstrate the economic advantages of implementing the Smart UVC Disinfection Tunnel in terms of reduced contamination risks and potential savings. 9. **User Training:** Provide comprehensive training to personnel responsible for operating and maintaining the tunnel to ensure its proper and safe use.

	10. **Environmental Considerations:** Assess the environmental impact of the system, including energy consumption and the disposal of UVC lamps, and explore sustainable alternatives. 11. **Customer Support:** Establish a robust customer support system to address any technical issues, questions, or concerns that food and pharmaceutical companies may have during and after implementation. 12. **Documentation:** Create detailed documentation, user manuals, and guidelines to facilitate the setup, operation, and troubleshooting of the Smart UVC Disinfection Tunnel. 13. **Continuous Improvement:** Commit to ongoing research and development to enhance the technology, incorporating feedback from users and staying up-to-date with advancements in UVC disinfection methods. Addressing these aspects will be crucial in the successful development and deployment of a Smart UVC Disinfection Tunnel for food and pharmaceutical companies, ensuring it meets industry requirements and provides tangible benefits.
6	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service The target market for the FYP project, "Smart UVC Disinfection Tunnel for Food and Pharmaceutical Companies," primarily includes industries and businesses in the food and pharmaceutical sectors. These industries have stringent hygiene and safety requirements, making them ideal candidates for such a product. 1. **Food Processing Companies:**Food processing plants, including meat, dairy, and vegetable processing facilities, are a key target. They need to maintain high sanitation standards to ensure the safety of their products. 2. **Pharmaceutical Manufacturers:** Pharmaceutical companies require sterile environments for drug production to prevent contamination, making them a crucial end-user. 3. **Healthcare Facilities:**Hospitals and clinics can benefit from UVC disinfection tunnels to ensure the cleanliness of medical equipment and facilities. 4. **Research Laboratories:**Laboratories conducting sensitive experiments and research in both food science and pharmaceuticals can enhance their contamination control measures. 5. **Logistics and Warehousing:** Companies responsible for storing and transporting pharmaceuticals and food items can use these tunnels to disinfect incoming and outgoing shipments. 6. **Government Health Agencies:**Public health authorities and regulatory bodies might recommend or mandate the use of such tunnels in certain industries. It's important to note that while the primary target is industries, there could be secondary markets as well: 7. **Educational Institutions:**Universities and research institutions may use the technology for research purposes.

	8. **Large Families:**Individuals with large families who want to ensure extra safety with groceries and supplies could be potential customers. 9. **Startup Businesses:**New food or pharmaceutical companies looking to establish a reputation for safety and quality might invest in this technology. 10. **Event Organizers:**Those responsible for organizing large gatherings, such as food festivals or pharmaceutical conferences, could use these tunnels to enhance safety. Understanding the diverse range of potential end-users and tailoring marketing efforts accordingly will be essential for the success of this project.	
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