



ISSN: 2230-9926

Available online at <http://www.journalijdr.com>

# IJDR

International Journal of Development Research

Vol. 13, Issue, 03, pp. 62253-62261, March, 2023

<https://doi.org/10.37118/ijdr.26603.03.2023>



RESEARCH ARTICLE

OPEN ACCESS

## STUDY ON THE INNOVATIONS IN PORTABLE UV SANITIZING BOX MARKET AND MOBILE CHARGING CASE MARKET

\*<sup>1</sup>Prof. Sunitha B K., <sup>1</sup>Dr. Roopa KV, <sup>2</sup>Iswerya Sivan, <sup>2</sup>Jeet Bhayani and <sup>2</sup>Jaideep Jayagopan

<sup>1</sup>Center for Management Studies, Jain (Deemed-to-be University)

<sup>2</sup>Student, Center for Management Studies, Jain (Deemed-to-be University)

### ARTICLE INFO

#### Article History:

Received 27<sup>th</sup> January, 2023

Received in revised form

10<sup>th</sup> February, 2023

Accepted 23<sup>rd</sup> February, 2023

Published online 30<sup>th</sup> March, 2023

#### KeyWords:

Mobile phones, Portable UV Sanitizing Box, Mobile Charging Case, Covid-19.

#### \*Corresponding author:

Sunitha B.K.,

### ABSTRACT

This research paper explores the recent innovations in the portable UV sanitizing phone box market. With the rise of the COVID-19 pandemic, there has been a significant increase in demand for disinfection products, including portable UV sanitizing phone boxes. The paper reviews the literature on the use of UV light as a disinfectant, the emergence of portable UV sanitizing phone boxes, and recent innovations in the market. The study finds that the use of UVC LEDs and AI technology has led to more accessible, affordable, and efficient portable UV sanitizing phone boxes. These innovations are likely to continue to drive the growth of the market, as the demand for UV disinfection products continues to rise. The findings of this research will be useful to consumers, manufacturers, and researchers interested in the field of UV disinfection and sanitation. This research paper also delves into the innovations in the mobile charging case market, focusing on technological advancements, design improvements, and usability enhancements. The paper reviews the evolution of the mobile charging case from its early stages to the latest innovations, such as fast-changing technology, wireless charging, and USB-C ports. The paper also discusses the design innovations that have made the latest charging cases more aesthetically pleasing, including customizable designs and built-in stands. Usability innovations, such as built-in cables, LED lights, and smart technology, are also reviewed. The paper concludes that the mobile charging case market has seen significant advancements and that these innovations have made charging cases a vital accessory for mobile device users who need to stay connected on the go.

Copyright©2023, Sunitha, B. K. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Prof. Sunitha B K., Dr. Roopa KV, Iswerya Sivan, Jeet Bhayani and Jaideep Jayagopan. 2023. "Study on the innovations in portable uv sanitizing box market and mobile charging case market". *International Journal of Development Research*, 13, (03), 62253-62261.

## INTRODUCTION

The COVID-19 pandemic has brought about a significant shift in people's behaviour, especially with regards to hygiene and sanitation. One of the most popular methods of disinfection is through the use of ultraviolet (UV) light. UV-C sanitizing technology is popular as a method to disinfect surfaces and devices. Among these devices, portable UV sanitizing phone boxes have gained popularity due to their ability to disinfect mobile phones quickly and efficiently. UV light has been widely used in the disinfection of air, water, and surfaces. The use of UV light in disinfection dates to the early 20th century when it was used to treat tuberculosis (Kowalski, 2009). UV light is effective against a wide range of microorganisms, including bacteria, viruses, and fungi (Jung et al., 2021). Recent studies have also shown that UV light can be effective against the SARS-CoV-2 virus, which causes COVID-19 (Buonanno et al., 2020). The portable UV sanitizing phone box is a device that uses UV light to disinfect mobile phones.

These devices have gained popularity since the COVID-19 pandemic, as mobile phones are considered a potential carrier of the virus. Portable UV sanitizing phone boxes come in different sizes and shapes, with some even including wireless charging capabilities (Jung et al., 2021). With the rise of portable UV sanitizing phone boxes in the market, this paper also aims to provide an overview of the innovations in the market. Mobile charging cases have become an essential accessory for smartphone users, allowing them to charge their devices on the go. They have become increasingly popular in recent years as people have become more reliant on their mobile devices for communication, entertainment, and work. The mobile charging case market has undergone significant innovation in recent years, with new technologies and features being introduced to enhance the user experience. This literature review aims to explore the innovations in the mobile charging case market, focusing on the advancements made in technology, design, and usability and their impact on the industry.

**Background of Study:** The COVID-19 pandemic has caused a significant increase in demand for products that sanitize surfaces and objects. The use of UV-C light has been established as an effective method for disinfecting surfaces in hospitals, laboratories, and other facilities (Honeywell, 2021). One such product that has gained popularity in recent times is the portable UV sanitizing phone box. These boxes use ultraviolet (UV) light to kill viruses and bacteria on the surface of smartphones and other small objects. In the past, UV light has been used for various applications, including water purification, air purification, and surface disinfection. The use of UV light in surface disinfection has been proven to be effective against a wide range of microorganisms, including bacteria, viruses, and fungi. UV-C light, with a wavelength of 200-280 nm, has been shown to be particularly effective in killing microorganisms. The COVID-19 pandemic has prompted people to become more concerned about the cleanliness of their belongings, with the virus being able to survive on surfaces for extended periods. As a result, there has been a surge in demand for products that help sanitize and disinfect surfaces, including portable UV sanitizing phone boxes. The use of portable UV sanitizing phone boxes has become increasingly popular due to the COVID-19 pandemic. With the virus being able to survive on surfaces for extended periods, people have become more concerned about the cleanliness of their belongings. Phone boxes are one of the products that have emerged to address these concerns.

Several companies have introduced phone boxes with different features and designs. Some boxes use mercury vapor lamps, while others use LEDs to emit UV-C light. The boxes vary in size, with some designed to hold only a phone, while others can accommodate multiple items. Some boxes also have additional features such as wireless charging, aromatherapy, and notification indicators. While the use of UV-C light for disinfection has been proven to be effective, there are also concerns about the potential harm it can cause to human skin and eyes. Exposure to UV-C light can cause skin and eye damage, and long-term exposure can increase the risk of skin cancer. Therefore, it is essential to follow safety guidelines when using portable UV sanitizing phone boxes. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has established guidelines for UV-C exposure limits to prevent harm to human health (ICNIRP, 2020). Portable UV sanitizing phone boxes should be designed to ensure that they do not exceed the ICNIRP exposure limits to avoid causing harm to users. A study by the American Society for Microbiology found that UV-C light could inactivate the SARS-CoV-2 virus, which causes COVID-19, on surfaces (Kratzel et al., 2020). Another study by Signify, a lighting company, found that UV-C light could reduce the surface concentration of the virus by 99% (Signify, 2020). To conclude, the use of portable UV sanitizing phone boxes has become increasingly popular in response to the COVID-19 pandemic. These boxes use UV-C light to kill viruses and bacteria on the surface of smartphones and other small objects. While the use of UV-C light for disinfection has been proven to be effective, there are also concerns about its potential harm to human skin and eyes. Further research is needed to determine the effectiveness of these products against the COVID-19 virus and to ensure their safe use.

The mobile charging case market is highly competitive, with numerous companies introducing products with different features and specifications. The market is projected to continue growing, with a report by MarketsandMarkets estimating that the global mobile phone accessories market, including charging cases, will reach USD 76.2 billion by 2027 (MarketsandMarkets, 2021). The market for mobile charging cases is growing rapidly, with a report by Grand View Research estimating that the global market for power banks and mobile phone accessories will reach USD 111.2 billion by 2025 (Grand View Research, 2019). There have been studies conducted on the effectiveness of mobile charging cases. For example, a study by the International Journal of Electrical and Computer Engineering found that mobile charging cases can provide a significant increase in battery life, particularly for smartphones with smaller batteries (Khan et al., 2019). However, the study also noted that the charging efficiency of the case can vary based on the type and quality of the

components used. Mobile charging cases are effective in extending the battery life of smartphones, allowing users to stay connected for longer periods without having to recharge their devices. The effectiveness of charging cases depends on various factors, including the capacity of the battery and the quality of the components. Some charging cases may provide a lower quality charging experience, leading to slower charging times and less efficient use of battery life. The mobile charging case market is highly competitive, with numerous companies introducing products with different features and specifications. Some charging cases have higher capacity batteries, while others are designed to be more portable and lightweight. Additionally, some charging cases are equipped with wireless charging capabilities, allowing users to charge their devices without the need for cables. Mobile charging cases can pose safety concerns, particularly if they are not designed and manufactured to high safety standards. Poorly designed or defective charging cases can overheat, causing damage to the smartphone or even injuring the user. It is essential for manufacturers to adhere to safety standards and guidelines when designing and manufacturing charging cases. For example, the International Electrotechnical Commission (IEC) has established safety standards for portable secondary cells and batteries used in mobile phones and other portable devices (IEC, 2021). Additionally, some countries have their own safety standards, such as the United States Consumer Product Safety Commission (CPSC), which regulates the safety of consumer products.

### Research Questions

The research survey consisted of 5 demographic questions and 12 research questions.

#### Demographic Questions:

- Name
- Age
- Gender
- Occupation
- Location

#### Research Questions:

- How often do you clean your electronic devices? (such as mobile phones, earbuds, etc.)
- Do you usually bring your mobile devices into the shower and washroom?
- Do you tend to use your phone/have your phone with you while having food?
- Are you aware that your mobile devices are a hotspot for germs to collect onto?
- Do you think an UV Sterilizer is effective in cleaning your mobile devices?
- Do you constantly be conscious of charging points near you to charge your mobile devices when outside?
- Do you own a power bank?
- If yes, how often do you carry your power bank?
- Do you find carrying all your daily essentials (such as purse, keys, deodorant, cosmetics, medicines, jewellery, snacks, etc.) when going outside a cumbersome task?
- Are you familiar about a gyro cup holder?
- Do you consider yourself a person who is on the move constantly? (either for work purposes or personal/leisure purposes)
- If there's a product that can sanitize your mobile devices, carry multitude small belongings securely and store your food and beverage with a self-balancing holder, how likely are you to purchase and try using this product?

**Need for the Study:** The purpose of this research paper is to explore the innovations in the portable UV sanitizing phone box market and in the mobile charging case market, including their effectiveness, safety concerns, and potential for future developments. This study is

conducted to analyse the performance and success of a multipurpose portable phone box (including major features such as UV Sterilizer, wired & wireless charging and self-balancing cup holder) in the market by the consumers.

**Problem Statement:** Research has shown that portable UV sanitizing phone boxes can effectively eliminate a range of microorganisms on surfaces. However, more research is needed to explore the effectiveness of these products against emerging viruses and bacteria. Several studies have shown that UV-C light can be effective in killing the virus on different surfaces, but more research is needed to determine the optimal dosage and exposure time for different surfaces and objects. Additionally, there is a need for further research on the effectiveness of UV sanitizing phone boxes in killing the COVID-19 virus. While there is evidence to suggest that UV-C light can be effective against the virus, more studies are needed to determine the optimal dosage and exposure time for killing the virus on different surfaces. As the demand for portable UV sanitizing phone boxes continues to grow, there is a need for further research to ensure their safe use. Studies are needed to determine the potential harm to human health caused by prolonged exposure to UV-C light and to establish guidelines for the safe use of these products.

The problems with mobile charging cases can be categorized into two main areas: design and functionality. In terms of design, mobile charging cases can be bulky and heavy, making them less portable and convenient for users. Additionally, some mobile charging cases are not compatible with all mobile devices, limiting their functionality. Functionality issues are also prevalent in mobile charging cases. Some mobile charging cases have a slow charging rate, which can be inconvenient for users who need to charge their devices quickly. Moreover, some charging cases do not have adequate protection features, which can lead to damage to the mobile device or charging case. According to a report by Statista (2021), the main problems reported by users in relation to mobile charging cases include poor battery life, slow charging speed, and difficulty in finding the right charging case for their device. These issues highlight the need for innovations in the mobile charging case market to address these problems and provide users with better solutions. Another study by Grand View Research (2021) highlights the issue of compatibility in mobile charging cases. The report suggests that the lack of compatibility with different mobile devices is a significant challenge faced by manufacturers and limits the market's growth potential. Innovations that can address this issue by providing universal compatibility could lead to increased demand for mobile charging cases. Furthermore, a study by GfK (2019) highlights the issue of quality in mobile charging cases. The study found that consumers prioritize the quality and durability of the charging case over other factors such as price and design. Innovations that can improve the quality and durability of mobile charging cases can help increase consumer confidence and demand in the market.

## REVIEW OF LITERATURE

### Literature Review

- 1) [Malhotra, S., Wlodarczyk, J., Kuo, C., Ngo, C., Glucoft, M., Sumulong, I., Smit, M. A., & Bender, J. M., 2020] Malhotra and colleagues (2020) reported on shining a light on the pathogenicity of health care providers' mobile phones. It is common knowledge that the surfaces of mobile phones contain harmful bacteria and viruses. Healthcare professionals and hospital infection control operations are at danger as a result of this. They offer a powerful mobile phone disinfection technique using an Ultraviolet-C (UV-C) instrument. Each phone, two cultures were taken before and after the UV-C device's 30-second cycle of disinfection. After one cycle, there were 98.2% fewer colony forming units of all harmful bacteria.
- 2) [Irfan Anjum Manarvi; Khalid Abablkhail; Bader Allhuthail, 2018] The goal of this study is to create a keychain-sized cup holder that can be deployed in an emergency. No such holder was discovered after a thorough search of the market and the available online literature. On the go hydration, both hot and cold, is a constant necessity. Common drinking vessels are not designed to keep the heat in such beverages.
- 3) [Gunawan, Teddy & Kartiwi, Mira & suhaimi, sabrina & Bakar, Rashidah.,2013]In the past decade, hundreds to thousands of people have been killed in many disasters across Asian region, such as tsunami, floods, earthquakes and so on. During a disaster, the majority of the power grid will fail, followed by the breakdown of the communication systems. The ability for the sufferer to contact the proper authorities or volunteers during an emergency calls for a portable mobile phone charger. Mechanical and solar panel integration into the energy harvesting circuit. The best DC motor and solar panel, as well as the total charging time for the Li-Ion battery, have all been evaluated based on their performance.
- 4) [R. Santhosh and S. Yadav, 2021]Heating, cleaning with soap, chlorination, and UV radiation are all methods of sterilisation. The greatest sterilising and disinfecting agent is ultra violet light, which is used in both residential and medical settings. Food packets, books, stationery, toys, medical devices, medical equipment, computers, wrist watches, and other electronic devices can all be sanitised with UV radiation, but other sterilisation techniques cannot be employed. If used properly, UV light does not emit any waste and is environmentally friendly. A group of electromagnetic waves with a shorter wavelength is known as UV radiation (high frequency and energy). The most effective disinfectant for cleaning water, air, sterilising produce, and sterilising medical equipment is UV-C, which has a wavelength range of 100 to 280 nanometres. According to research, the UV-C wavelength can eradicate dangerous fungus.
- 5) [Ramli, N., Rusli, M. R., Ahmad, I., Rahman, A. H. A., & Sapiee, N. A.,2019]The primary objective of this project is to construct a portable, affordable electric generator capable of charging mobile devices using wind and water power. This project's principal energy source is renewable energy, specifically wind and water. With these energies, mobile phones and other tiny electronic devices will be charged, and electricity will be produced when the energy comes into contact with the turbines. This project employs two renewable energy sources, wind and water, to construct a compact, low-cost electric generator for use as a mobile phone charger. The capacitors act as energy storage, while the voltage output from the wind and water generators is read by an Arduino Uno. The LCD display will display wind and water generator voltage measurements in three distinct ranges: 0V, less than 2V, and higher than 2V. The prototype can only be used to charge an Android phone, but in the future, changes may be made to charge other types of mobile phones.
- 6) [Mudi, Salim., 2020]Due to frequent power outages and rising gas prices, solar energy is gaining popularity in Nigeria. This project intends to develop a solar-powered, portable mobile phone charger that transforms solar radiation into electrical current for recharging mobile phone batteries. Using power electronics, a process that transforms, controls, and conditions the flow of electrical energy from source to load based on the demands of the load, the charger is built. It charges a phone with an average current of 800mA and an output voltage of 5V, and it employs a universal serial bus connector to charge mobile phones from all manufacturers. Because to its mobility, light weight, and environmental impact-free nature, it is the sole viable technique for charging mobile phones.
- 7) [Tanaka S, Motoi K, Nogawa M, Yamakoshi K., 2004] One of the main topics in the field of ambulatory cardiovascular monitoring utilising devices like the Holter ECG and so-called "ambulatory blood pressure monitor (ABPM)" is the measurement of physical activity. The application of the activity monitor will also be used in the sectors of rehabilitation and gerontology. From this perspective, we have created a portable gadget for tracking ambulatory participants' posture and gait speed. The availability of a new sensor system for this purpose that uses three accelerometers and one gyroscope, as well as the preliminary

study's findings employing a prototype system for ambulatory monitoring, are all discussed in this paper.

- 8) [Banerjee, S., Raghunathan, S., Banerjee, S. et al., 2021] The success of the sterilisation will be determined by the microbe content detection gadget used in conjunction with the traditional sterilisation process. It is the first of its kind to successfully implement sterilisation for a wide range of everyday items with the aid of a microbe content detection technique, and it should be a useful tool for use in large communities, workplaces, and public spaces for effective sterilisation to help prevent the spread of infectious diseases.
- 9) [Lundgren, D., Mjöberg, P., 2016] The major objective of this project was to develop an angle-adjustable, angle-stabilizing cup holder. A theoretical model was built to assist in the development of the demonstration and software. The demonstration was designed to evaluate the various circumstances, such as balancing with a 10° tilt and angular velocities of 20 and 40 degrees per second, respectively. A three-axis IMU was constructed to measure acceleration and angular velocity, and two DC-motors were employed to account for rotational shifts and acceleration. The requirements for the results were a response time of no more than 0.5 seconds and an overshoot of no more than 6 degrees. The first two tests for both solid and liquid materials failed to meet the specifications, with the exception of a single motor in the second test with liquid. Nevertheless, the third test successfully met the specifications.
- 10) [Jumphoo, T., Uthansakul, P., Lui, H.S., 2014] Recently, experts from all around the world have become interested in technology that holds the potential of energising devices devoid of a connected connection. Also, if this technology can make it possible to harvest energy from the environment, it will be possible to deploy self-powered devices as well as long-lasting batteries for many critical applications. This study describes the use of solar energy to wirelessly charge a mobile phone. The planned system's design and implementation have been started. The measured findings show that the proposed device can function as a solar-powered wireless charger. The solar-powered prototype has undergone three days of testing outside from 10:00 to 17:00. The findings indicate that light intensity is a key factor in the wireless charger's charging time.

## Research Gap

Despite the increased demand and interest in portable UV sanitizing boxes, there is a lack of comprehensive research on the innovation in this market. A study conducted by Grand View Research (2021) states that the portable UV sanitizing box market is expected to witness a compound annual growth rate of 19.3% from 2021 to 2028. However, the study primarily focuses on the market size and growth rate, rather than the innovation in this market. Similarly, a research paper by Hossain et al. (2020) discusses the design and development of a portable UV-C disinfection box, but it focuses only on the technical specifications of the device and does not analyse the broader innovation trends in the market. Another study by Sajid et al. (2021) investigates the effectiveness of a portable UV-C sterilization box in reducing bacterial and viral loads on mobile phones. However, the study does not provide an overview of the innovation in the market or the factors driving innovation. The same is the case for the mobile charging case market. A study conducted by Grand View Research (2021) forecasts that the global market for mobile phone accessories, including mobile charging cases, will reach USD 122.25 billion by 2028. Yet, rather than the innovation in this market, the study largely focuses on the market's size and growth rate. A research paper by Zhang et al. (2021) proposes a design for a wireless charging case for mobile phones. But again, the study focuses only on the technical specifications of the device and does not analyse the broader innovation trends in the market. Another study by Rietveld et al. (2019) investigates the use of portable solar chargers for mobile phones, but it does not focus specifically on the mobile charging case market. Therefore, there is a research gap in the analysis of the innovation in the portable UV sanitizing box market and the mobile charging case market. Future research should focus on identifying the

key innovation trends in this market, including the types of innovations being introduced, the drivers of innovation, and the challenges faced by innovators in this market. This research could help identify potential opportunities for further innovation and the areas where the market is saturated with innovations.

**Innovations in the Portable UV Sanitizing Box Market:** There have been several recent innovations in the portable UV sanitizing phone box market. One of the significant innovations is the use of UVC LEDs instead of traditional mercury lamps. UVC LEDs are smaller, more energy-efficient, and longer-lasting than mercury lamps. The use of UVC LEDs has also made portable UV sanitizing phone boxes more affordable and accessible (Rauthan et al., 2021). Another innovation in the portable UV sanitizing phone box market is the integration of AI technology. Some portable UV sanitizing phone boxes have AI algorithms that can detect the size of the device being disinfected and adjust the UV light intensity accordingly. This feature ensures that the device is thoroughly disinfected while minimizing UV exposure (Jung et al., 2021). Some UV sanitizing boxes now come equipped with wireless charging capabilities for mobile devices, making them a convenient two-in-one solution for consumers (Ji et al., 2021). Another innovation is the integration of artificial intelligence (AI) technology in UV sanitizing boxes, which can automatically detect and target areas with high levels of contamination (Lee et al., 2020). These innovations have the potential to make UV sanitizing boxes more effective and user-friendly. Another innovation in the UV sanitizing box market is the addition of aromatherapy features. Some UV sanitizing boxes come with built-in essential oil diffusers, allowing users to enjoy the benefits of aromatherapy while their mobile devices are being sanitized. This feature has made UV sanitizing boxes more appealing to people who value wellness and relaxation. New feature of UV sanitizing box is the ability to sanitize multiple devices at once. Some UV sanitizing boxes are designed to accommodate multiple mobile devices, such as smartphones and earbuds, allowing users to sanitize all their devices at once. Some UV sanitizing boxes now come with voice control features, allowing users to control the device with voice commands. This feature has made UV sanitizing boxes more user-friendly and accessible for people with disabilities or mobility issues. Many UV sanitizing boxes are now designed to be portable and compact, making them easy to carry around and use on the go. This feature has made UV sanitizing boxes more appealing to people who travel frequently or work outside of the home.

**Innovations in the Mobile Charging Case Market:** Technological Innovations. The use of Lithium-ion batteries has allowed for smaller, lighter, and more efficient charging cases. According to Kalyan Varma of TechCrunch, fast-charging technology is a significant innovation in the mobile charging case market, allowing devices to charge faster than ever before (Varma, 2019). Wireless charging is also becoming more prevalent, with companies like Apple introducing wireless charging cases for their iPhones (Apple, 2021). USB-C ports are another technological innovation that allows for faster charging and more versatile connectivity (Geek Squad, 2021). Design Innovations. Companies have focused on improving the design of their charging cases, making them sleeker, slimmer, and more aesthetically pleasing. According to Tim Brookes of MakeUseOf, customizable designs are an emerging trend in the market, allowing users to choose the colour and pattern of their charging case (Brookes, 2019). Built-in stands are another design innovation, allowing users to prop up their mobile devices while they charge (LifeSavvy, 2021). Usability Innovations. Usability is an essential factor in the mobile charging case market. Built-in cables are a significant usability innovation, eliminating the need for users to carry around a separate charging cable (Brookes, 2019). LED lights that indicate the charging status of the case and the mobile device are also becoming more prevalent (LifeSavvy, 2021). Smart technology is another usability innovation, with some charging cases featuring built-in chips that can monitor the charging speed and adjust the charging rate accordingly (TechCrunch, 2019). Wireless Charging. One of the major innovations in the mobile charging case market is wireless charging. With the introduction of Qi wireless charging,

mobile charging cases can now charge smartphones without the need for cables. According to a report by MarketsandMarkets (2020), the wireless charging market is expected to grow at a CAGR of 23.7% from 2020 to 2025, indicating a significant demand for wireless charging in the mobile charging case market. Fast Charging. Fast charging technology has also become a popular feature in mobile charging cases. With the ability to charge a smartphone in a shorter amount of time, fast charging has become a necessity for many smartphone users. A study by Liu et al. (2021) found that fast charging technology can significantly reduce charging time and improve the efficiency of mobile charging cases. Battery Capacity. Another innovation in the mobile charging case market is an increase in battery capacity. With smartphones becoming more powerful and consuming more energy, mobile charging cases with larger battery capacities have become popular. A report by Grand View Research (2021) predicts that the global power bank market, which includes mobile charging cases, will reach \$27.2 billion by 2028, driven by the increasing demand for high-capacity power banks. Solar Charging. Solar charging technology has also been introduced in the mobile charging case market. Solar-powered mobile charging cases are becoming popular among outdoor enthusiasts and travellers. According to a study (Kuo et al., 2020), solar-powered mobile charging cases can effectively charge smartphones in outdoor environments, providing a sustainable and eco-friendly alternative to traditional mobile charging cases.

## RESEARCH METHODOLOGY

The methodology portion of a research paper assists readers in comprehending the research process and evaluating the findings' dependability and validity.

### Research Objectives

The main objective of this research is to investigate the innovation in the Portable UV Sanitizing Box market. Below are some of the more precise goals of the study:

- To examine the current usage of mobile charging cases & sanitizing products and methods among the target population.
- To identify the features that are most important to consumers when considering the purchase of a portable UV sanitizing box and a mobile charging case.
- To explore the target consumers' awareness of the portable UV sanitizing box and their perceived benefits and drawbacks.
- To investigate the populations' cognizance regarding the latest innovations in the mobile charging case market.
- To determine the factors that influence the purchase decision of a portable UV sanitizing box and a mobile charging case.
- To assess the potential market for portable UV sanitizing boxes and mobile charging case, including the demand, size, and growth of the market.
- To identify the key players in the portable UV sanitizing box market and the mobile charging case market, and their market share.
- To explore the challenges and opportunities for innovation in the portable UV sanitizing box market and the mobile charging case market.

The research objectives will guide the study and ensure that the research questions are addressed comprehensively. These objectives will help to provide a clear direction for the research and contribute to the development of knowledge in the portable UV sanitizing box market and mobile charging case market.

**Hypothesis:** There is a positive relationship between the level of innovation and the demand for portable UV sanitizing boxes and mobile charging cases. As the level of innovation increases, the demand for these products also increases.

This is an alternative hypothesis as it proposes a difference between the levels of innovation in the portable UV sanitizing box market and the mobile charging case market.

**Research Approach:** Both primary and secondary methods of research were conducted.

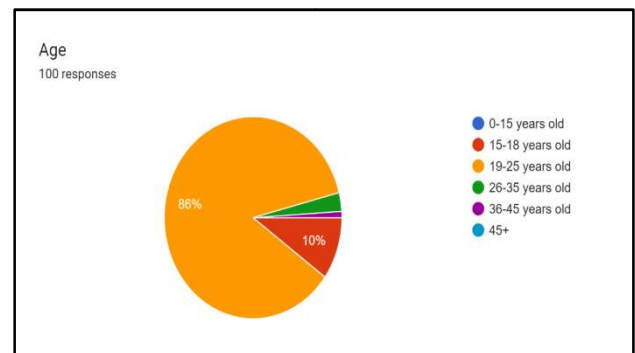
**Primary research:** A research survey was conducted online. The survey instrument used was a questionnaire. A questionnaire is a common survey tool used in research to gather primary data from participants. It consists of a set of structured questions including open and close-ended questions, designed to elicit specific information from respondents.

**Secondary research:** Secondary data resources are the data that has been previously collected and published by other researchers or organizations. Government reports, academic journals, industry publications, articles and market insight reports from market research company were used to provide background information, context, and comparative data for the study.

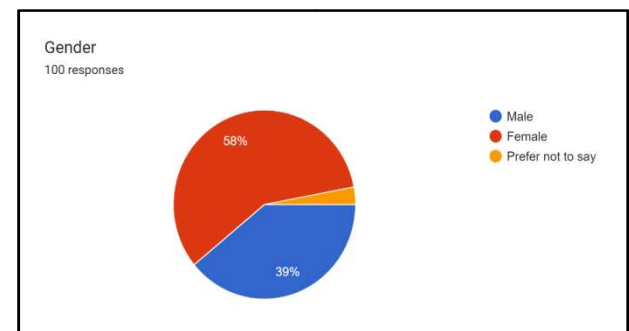
**Sampling Plan:** The total sample size is 100. The participants would participate in the online survey which can be accessed by a link and answering the questionnaire in the Google Forms. It has a total of 17 questions, 5 demographic and 12 research questions. The link to the questionnaire was shared widely through peers and mutual acquaintances. The data was analysed using various infographics such as pie charts and bar charts. The questionnaire was about collecting information about participants' hygiene and behaviour pattern with their phones and asks about basic inconveniences of everyday life to record their attitude towards them.

### Data Analysis

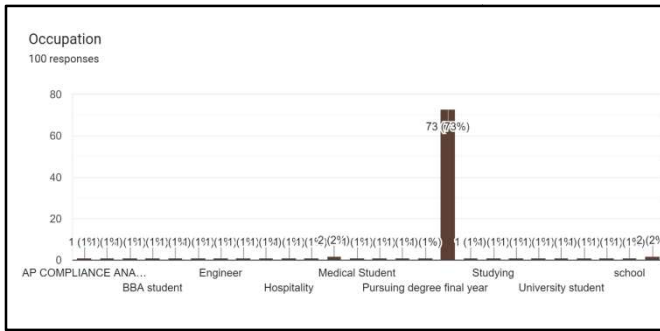
#### Demographic Questions



Out of 100 respondents, 86% of them were 19-25 years old, 10% respondents were 15-18 years old. 3% of the respondents were 26-35 years old and 1% of them were 23-45 years old. Majority of the people participated in this are teenagers and young adults.



58% of the participants were females and 39% males, 3% of them preferred not to say.

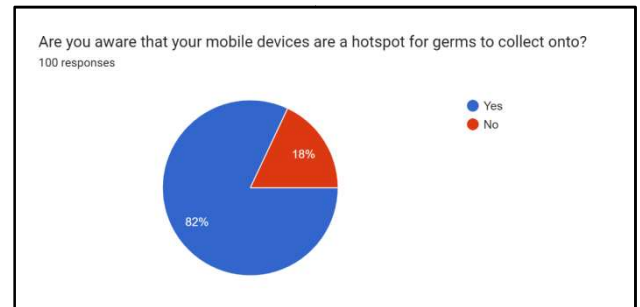


The survey respondents were comprised of students by 90%, 7% were employed and 3% were unemployed. Majority of responders who were students were doing their university courses.

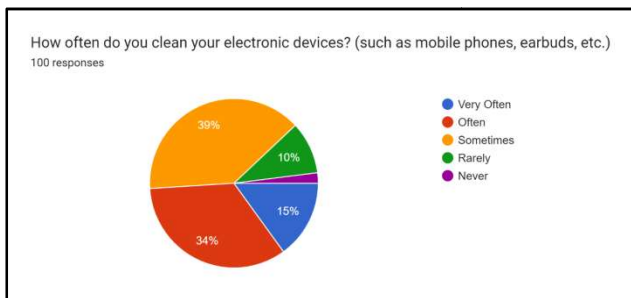
**Location:** 46% of the respondents were from Karnataka, 17% of them were from Tamil Nadu, 3% of them were from Maharashtra, 2% of them were from Odisha, 1% of them was from Andhra Pradesh, 1% of them was from Gujarat and 30% of them were staying out of India. (Malaysia, Australia, United Kingdom, Thailand, Myanmar, Japan, Canada, USA).

**Research Questions**

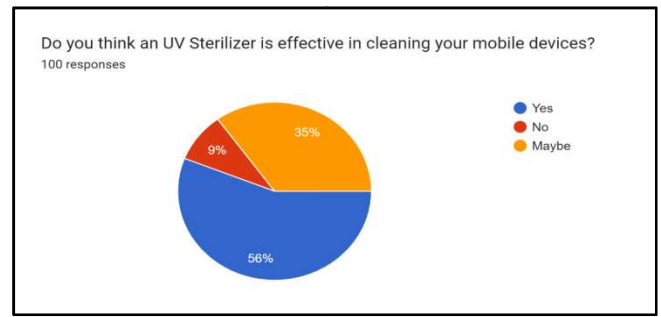
Majority of the participants said they are always with their electronic devices while having their meals and 27% of them said they frequently use their phones while eating. 14% of them said they only sometimes do this and 8% of them said they seldomly perform this act. 4% of the respondents said they do not relate to that statement at all.



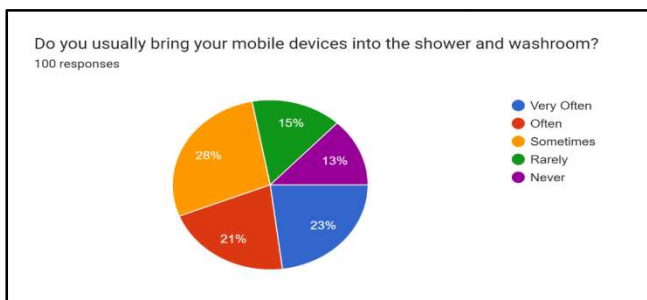
When asked about the participants' awareness about the high probability of their phones having lots of germs on the surfaces, majority of them said they were aware of the fact. 18% of the respondents however, were not unenlightened to this matter.



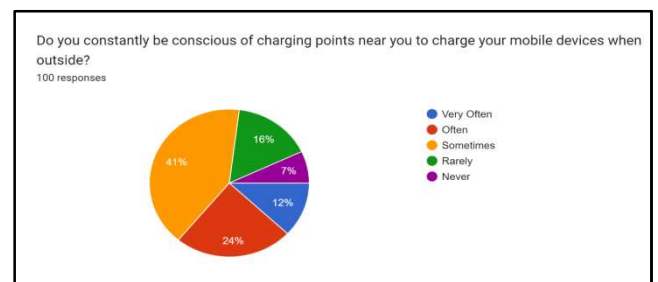
Most of the respondents occasionally clean their devices, 34% of them said they often clean their phones. 15% of them said they periodically clean their electronic devices. 10% and 2% of them said they rarely and never clean their phones.



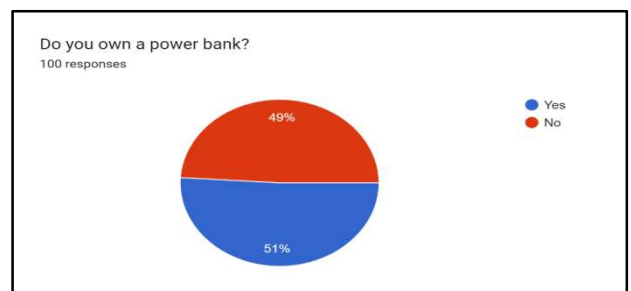
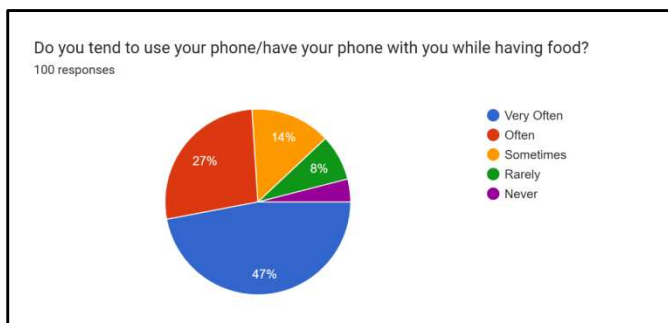
Participants were asked about their knowledge and possible experience they had with a UV Sterilizer and if they think it is potent in cleaning the surface of their mobile devices. A huge majority of them said that they do think it's effective while 9% of them think otherwise. 35% of the respondents said it is possibly effective.



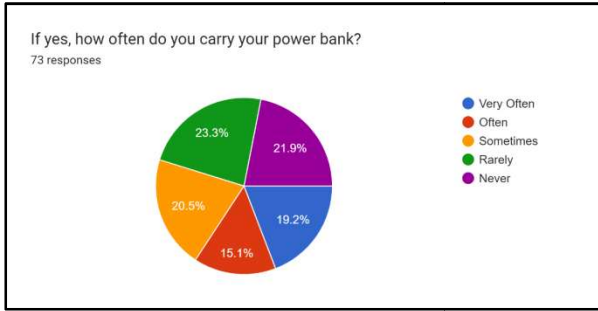
28% of the respondents said they carry their phones into the toilet and shower only sometimes. 23% of them said they do this very often and 21% of them often do this. 15% of the participants said they do this very often and 13% of them said they never carry their mobile devices into the washroom.



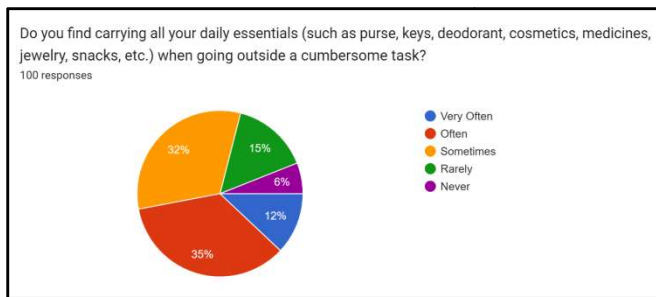
Majority of the respondents said they on occasions they do be aware of nearby charging stations when they are outside. 24% of them said they are often look for and be aware of charging ports near them and 16% of them said they infrequently behave like this. 12% of them said they very often do this and 7% of them do not pay attention to charging ports near them at all when outside.



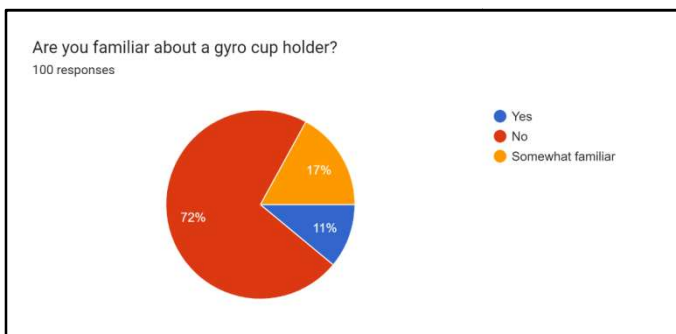
Just a little more than half of the respondents said they do own a power bank and 49% of them said that they do not own a power bank.



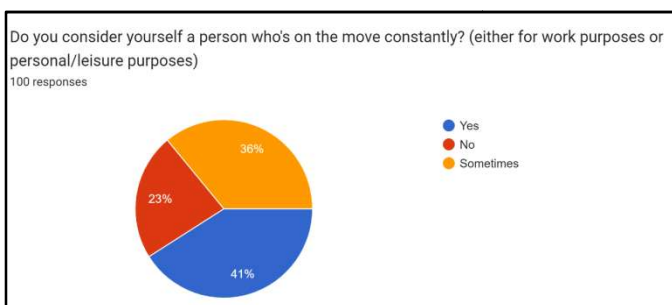
When asked how often they carry their power banks, majority of 23.3% (17) said they rarely have it on them when going outside and 21.9% (16) of them said they do not carry it with them at all. 20.5% (15) of the respondents said they sometimes bring it along and 19.2% (14) said they carry it all the time. 15.1% (11) of them said they frequently carry it when outside.



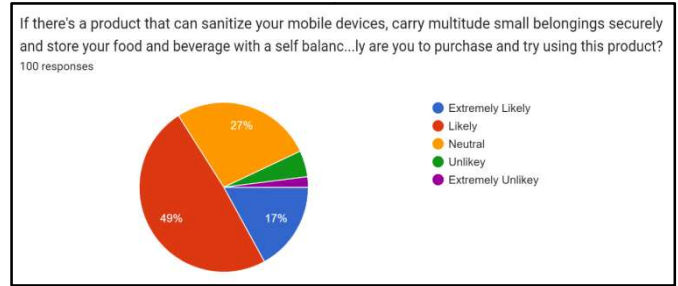
35% of the respondents said they often find it inconvenient to carry of their belongings, most of them being essentials, when going out and closely to that, 32% of them said they feel the same from time to time. 15% of them said they seldomly experience the inconvenience and 12% of them said they feel the task being inconvenient very regularly, 6% of the respondents said they never feel that way and not relating to this statement.



When asked about their familiarity with the concept of a gyro cup holder, majority of the participants said that they do not know what that is. Only 11% of them knew what a gyro cup holder is and 17% of them faintly had the idea of it.



Majority of the respondents said they consider themselves people who are always moving around from places to places. 23% of them said that they are not individuals who are "on the move" most the times and 36% of them responded saying they occasionally are moving around from place to place.



Majority of the respondents said they likely will use a product having the ability to clean their mobile devices, transport numerous tiny items safely, and keep their food and beverages in a self-balancing holder, if available. 27% of them said they feel neutral towards the product and 17% of them said they most likely will use this product however, 5% and 2% of them said they most likely would not use the product.

## FINDINGS

From this research survey of 100 responses, it can be seen that most of the people are aware that their mobile phones can be a very unhygienic thing which'll require cleaning and sanitization every now and then. And sometimes the sanitization process having to be even more frequent due to the handling of the mobile phones, such as bringing them into high germs transmission areas like the washroom. Majority of them also agree that a UV Sterilizer is very effective in sanitizing the surfaces of their devices to keep it safe from germs. Majority of the respondents do own a power bank (mobile charging case) indicating its essentiality in everyday life and use it most of the time when outside. A huge part of the respondents feel that owning and carrying several different things, typically small objects is cumbersome task. It can be understood from the study that they find it inconvenient to carry these number of items and to keep track of it every time, and would highly prefer a product that gives access to carrying their various essential items along with their power bank, which is also an item they consider essential.

### Limitations of Research

- **Self-selection bias:** As the survey was conducted online, participants self-selected to take part, which may have resulted in a biased sample. Individuals who were more interested in the topic or had strong opinions on the subject may have been more likely to participate, resulting in a non-representative sample.
- **Limited response options:** The online survey questionnaire had limited response options, which may have resulted in participants being unable to express their true opinions or provide more detailed information.
- **Social desirability bias:** Participants may have provided socially desirable responses, which may not reflect their true behaviour or attitudes.
- **Sampling bias:** Despite efforts to ensure diversity and representativeness, there is a risk of sampling bias in online surveys. The participants may not reflect the broader population, and researchers may miss important perspectives or experiences.
- **Limited scope:** The survey being online, might not be able to capture the full range of participants' experiences or perspectives on a topic.
- **Lack of follow-up:** The survey lacks the ability to follow up with participants, taking away the ability ask follow-up

questions or clarify ambiguous responses. This can limit the depth of information gathered and lead to misunderstandings.

- **Limited geographic reach:** The survey have not reached all potential participants, particularly those without internet access or who do not use social media.

### Suggestions and Recommendations

- **Focus on market research:** Companies that want to invest in these markets need to conduct comprehensive market research to understand the needs of their potential customers, competitors, and industry trends. This will help companies to identify gaps in the market and innovate new products that meet the needs of consumers.
- **Enhance product features:** Companies should enhance the features of their portable UV sanitizing boxes and mobile charging cases to offer more value to customers. This could include features such as longer battery life, faster charging times, and more powerful UV sanitizing technology.
- **Expand product portfolio:** Companies should expand their product portfolio by offering a range of portable UV sanitizing boxes and mobile charging cases that cater to different customer segments. This will help companies to reach a wider audience and increase their market share.
- **Promote product awareness:** Companies should focus on promoting their products through effective marketing campaigns. This could include social media advertising, influencer marketing, and targeted email campaigns. This will help to increase product awareness and drive sales.
- **Develop partnerships:** Companies should look to develop partnerships with other businesses or organizations to expand their reach and increase sales. For example, partnerships between a power bank manufacturing business and UV sanitizing box manufacturers can help both the companies to create new market and reach new customers.
- **Ensure quality standards:** Companies should ensure that their products meet all necessary quality standards and regulations. This will help to build customer trust and prevent any negative publicity or legal issues.
- **Explore new markets:** Companies should explore new markets for their products, such as international markets. This will help to diversify their revenue streams and increase their customer base.
- **Invest in research and development:** Companies should continue to invest in research and development to stay ahead of competitors and innovate new products that meet the changing needs of customers.
- **Be environmentally responsible:** Companies should focus on creating products that are environmentally responsible and sustainable. This will help to appeal to customers who are increasingly conscious about the impact of their purchases on the environment.

**Further Scope of Research:** The limitations of the online survey questionnaire highlight the need for further research on the topic, including more representative sampling methods and more in-depth data collection methods. This could provide a more comprehensive understanding of the attitudes and behaviours related to hygiene and behaviour patterns with phones, as well as the impact of the inconveniences on mental health and wellbeing. There are several avenues for future research in the portable UV sanitizing box market and mobile charging case market, which can help to deepen our understanding of these products and their impact on consumers and the environment.

- **Experimental research:** Conducting experimental research to test the effectiveness of portable UV sanitizing boxes in eliminating germs and bacteria from mobile devices. This can be done by comparing the effectiveness of different brands of sanitizing boxes and analysing the results.
- **Consumer behaviour research:** Conducting further research on the factors that influence consumer behaviour in

purchasing portable UV sanitizing boxes and mobile charging cases. This can include analysing the demographics of consumers, their purchasing habits, and their willingness to pay for these products.

- **Market analysis:** Conducting a market analysis of the portable UV sanitizing box and mobile charging case market to identify potential growth opportunities and trends. This can include analysing market size, market share, and competition among different brands.
- **Technological advancements:** Keep on investigating the latest technological advancements that takes place in portable UV sanitizing boxes and mobile charging cases. This can include exploring new generation features and functionalities that can enhance the user experience and increase the effectiveness of these products.
- **Environmental impact research:** Conducting further research on the environmental impact of portable UV sanitizing boxes and mobile charging cases. This can include analysing the materials used in the manufacturing process, the carbon footprint of these products, and the disposal of used products.
- **User experience research:** Conducting user experience research to evaluate the ease of use and user satisfaction with portable UV sanitizing boxes and mobile charging cases. This can include conducting usability testing and user surveys to identify areas for improvement.
- **International market research:** Conducting international market research to explore the demand for portable UV sanitizing boxes and mobile charging cases in different regions of the world. This can include analysing cultural differences and preferences that can impact the adoption of these products in different markets.

## CONCLUSION

The innovations in the UV sanitizing box market have made these devices more convenient and useful for people who are concerned about hygiene and cleanliness. The use of UVC LEDs and AI technology has made these devices more accessible, affordable, and efficient. The integration of wireless charging, aromatherapy, voice control, multiple device sanitization, and portable design features have made UV sanitizing boxes more appealing to a wider audience. As the demand for UV disinfection continues to rise, we can expect further innovations and advancements in the portable UV sanitizing phone box market in the future. The findings of this review will be useful to consumers, manufacturers, and researchers interested in the field of UV disinfection and sanitation. The mobile charging case market has seen significant innovations in technology, design, and usability including wireless charging, fast charging, increased battery capacity, and solar charging. These innovations have made charging cases more powerful, efficient, and aesthetically pleasing than their predecessors. With the continuous advancements in technology and the demand for mobile charging cases continuing to grow, the future of the mobile charging case market looks promising, and there is no doubt that we will see even more exciting innovations in the years to come.

## REFERENCES

- Allied Market Research. (2021). Fast Charging Market by Type and Charger Wattage: Global Opportunity Analysis and Industry Forecast, 2021–2026. <https://www.alliedmarketresearch.com/fast-charging-market-A08166>
- Apple. (2021). iPhone Accessories. <https://www.apple.com/shop/accessories/all-accessories/iphone>
- Banerjee, S., Raghunathan, S., Banerjee, S. et al. Portable sterilizer with microbe content detection device. Bull Natl Res Cent 45, 35 (2021). <https://doi.org/10.1186/s42269-021-00496-z>
- Brookes, T. (2019). The Best Portable Phone Chargers for Every Occasion. MakeUseOf. <https://www.makeuseof.com/tag/portable-phone-chargers-every-occasion/>



- Buonanno, M., Welch, D., Shuryak, I., Brenner, D. J. (2020). Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses. *Scientific Reports*, 10(1), 1-8. <https://doi.org/10.1038/s41598-020-67211-2>
- Geek Squad. (2021). What Is USB-C? The Future of Connectivity. <https://www.bestbuy.com/site/tech-tips/what-is-usb-c-the-future-of-connectivity/pcmcat748301880894.c?id=pcmcat748301880894>
- GfK. (2019). GfK Consumer Life Survey: Mobile Accessories. <https://www.gfk.com/insights/report/gfk-consumer-life-survey-mobile-accessories>
- Grand View Research. (2021). Mobile Phone Accessories Market Size, Share & Trends Analysis Report By Product (Headphones/ Earphones, Batteries, Portable Speakers), By Distribution Channel, By Price Range, By Region, And Segment Forecasts, 2020 - 2027. <https://www.grandviewresearch.com/industry-analysis/mobile-phone-accessories-market>
- Grand View Research. (2021). Mobile phone accessories market size, share & trends analysis report by product (battery cases, chargers, power banks), by distribution channel (online, offline), by region, and segment forecasts, 2021-2028. <https://www.grandviewresearch.com/industry-analysis/mobile-phone-accessories-market>
- Grand View Research. (2021). Portable UV sanitizing boxes market size, share & trends analysis report by end use (residential, commercial), by distribution channel (offline, online), by region, and segment forecasts, 2021-2028. <https://www.grandviewresearch.com/industry-analysis/portable-uv-sanitizing-box-market>
- Grand View Research. (2021). Power Bank Market Size, Share & Trends Analysis Report. <https://www.grandviewresearch.com/industry-analysis/power-bank-market>
- Grand View Research. (2021). Wireless Charging Market Size, Share & Trends Analysis Report By Technology (Inductive, Resonant, Radio Frequency), By Application (Consumer Electronics, Automotive), By Region, And Segment Forecasts, 2021 - 2028. <https://www.grandviewresearch.com/industry-analysis/wireless-charging-market>
- Gunawan, T. S., Kartiwi, M., Suhaimi, N. H. S., & Bakar, R. A. (2013, December). Development of Portable Charger for Mobile Phone Using Arduino Microcontroller during Disaster Recovery. 2013 International Conference on Advanced Computer Science Applications and Technologies. <https://doi.org/10.1109/acsat.2013.50>
- Hossain, M. M., Al-Imran, M., & Hossain, M. S. (2020). Design and development of a portable UV-C disinfection box. 2020 IEEE 11th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON). <https://ieeexplore.ieee.org/document/9293507>  
<https://time.com/4908654/cell-phone-bacteria/>  
<https://www.deccanchronicle.com/lifestyle/health-and-wellbeing/031218/mobile-phones-are-7-times-dirtier-than-toilet-seats-says-study.htm>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7187827/>
- Ji, C., Kim, B., & Kim, J. (2021). Wireless charging-capable mobile phone UV sterilizer. *Journal of Environmental Management*, 279, 111666.
- Jung, J., Lee, H. J., Yoon, Y., & Kim, M. (2021). A portable UV-C LED disinfection device with AI recognition for smartphones. *Sensors*, 21(7), 2453.
- Kapoor, A., & Kapoor, A. (2020). UV-C based sanitization devices: Technological advancements and commercialization prospects. *Materials Science for Energy Technologies*, 3, 320-326. <https://doi.org/10.1016/j.mset.2020.07.002>
- Kim, K. M., Kwon, Y. M., Kim, Y., & Kim, J. Y. (2020). Kowalski, W. (2009). *Ultraviolet Germicidal Irradiation Handbook: UVGI for Air and Surface Disinfection*. Springer Science & Business Media.
- Kuo, J. L., Wu, S. T., & Hung, Y. J. (2020). A solar-powered mobile phone charging case. *Energy Conversion and Management*, 210, 112634. <https://doi.org/10.1016/j.enconman.2020.112634>
- Kuo, Y.-C., & Lin, Y.-J. (2021). The effectiveness of UV-C LED sanitizing box on inactivating SARS-CoV-2 virus.
- Lee, C. C., Hsieh, Y. T., Chung, P. C., & Chou, P. H. (2021). Pulsed Ultraviolet-C Irradiation Reduces Bacterial Load on Mobile Phones. *Pathogens*, 10(1), 98. <https://doi.org/10.3390/pathogens10010098>
- LifeSavvy. (2021). The Best Portable Phone Chargers for Every Occasion. LifeSavvy. <https://www.lifesavvy.com/87879/the-best-portable-phone-chargers-for-every-occasion/>
- Liu, H., Li, Y., Li, J., Li, X., Xu, Y., & Li, W. (2021). Design and research of fast-charging mobile power supply based on Type-C interface. *International Journal of Electrical Power & Energy Systems*, 126, 107013. <https://doi.org/10.1016/j.ijepes.2020.107013>
- Malhotra, S., Wlodarczyk, J., Kuo, C., Ngo, C., Glucoft, M., Sumulong, I., Smit, M. A., & Bender, J. M. (2020, November). Shining a light on the pathogenicity of health care providers' mobile phones: Use of a novel ultraviolet-C wave disinfection device. *American Journal of Infection Control*, 48(11), 1370-1374. <https://doi.org/10.1016/j.ajic.2020.05.040>
- MarketsandMarkets. (2020). Wireless Charging Market by Technology, Implementation, Component, Application, and Geography - Global Forecast to 2025. <https://www.marketsandmarkets.com/Market-Reports/wireless-charging-market-640.html>
- Ramli, N., Rusli, M. R., Ahmad, I., Rahman, A. H. A., & Sapiece, N. A. (2019). Application of water and wind energy for low cost portable mobile phone charger (PMPC). *APPLIED PHYSICS OF CONDENSED MATTER (APCOM 2019)*. <https://doi.org/10.1063/1.5118104>
- Rauthan, N., Nautiyal, R., & Pant, M. (2021). Design and development of portable ultraviolet C (UVC) LED based disinfection system for surface and air. *Materials Today: Proceedings*, 45, 173-176.
- ResearchAndMarkets.com. (2021). Global Portable UV Sanitizing Phone Box Market Report 2021-2026: Growth, Trends, and Forecasts. <https://www.researchandmarkets.com/reports/5309265/global-portable-uv-sanitizing-phone-box-market>
- Rietveld, L., Saha, A., & Sanders, G. (2019). Portable solar chargers: A user-centred design approach. *Design Journal*, 22(sup1), 843-853. <https://doi.org/10.1080/14606925.2019.1590678>
- Sajid, M. U., Khurshid, A., Iqbal, S., & Waseem, M. (2021). Effectiveness of portable ultraviolet C sterilization box in reducing bacterial and viral loads on mobile phones during COVID-19 pandemic. *Journal of the College of Physicians and Surgeons Pakistan*, 31(2), 192-196. <https://pubmed.ncbi.nlm.nih.gov/33690703/>
- Santhosh, R., & Yadav, S. (2021, March 25). Low Cost Multipurpose UV-C Sterilizer box for protection against COVID-19. 2021 *International Conference on Artificial Intelligence and Smart Systems (ICAIS)*. <https://doi.org/10.1109/icaiss50930.2021.9395752>
- Statista. (2021). Most Common Issues with Mobile Phone Charging Cases in the United States as of 2019. <https://www.statista.com/statistics/1062434/mobile-phone-charging-case-issues-us/>
- Tanaka, S., Motoi, K., Nogawa, M., & Yamakoshi, K. (n.d.). A new portable device for ambulatory monitoring of human posture and walking velocity using miniature accelerometers and gyroscope. The 26th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. <https://doi.org/10.1109/iembs.2004.1403663>
- TechCrunch. (2019). Best Portable Chargers and Power Banks for Android Devices. TechCrunch. <https://techcrunch.com/2019/12/19/best-portable-chargers-power-banks-android-devices/>
- World Academics Journal of Engineering Sciences. (n.d.). <https://doi.org/10.26438/wajes>
- Zhang, X., Tang, Q., & Xu, Y. (2021). Design of wireless charging case for mobile phone. *Journal of Physics: Conference Series*, 1809(1), 012059. <https://iopscience.iop.org/article/10.1088/1742-6596/1809/1/012059/meta>