Evaluating the Application of Bird Repellent Technology in In-Flight Systems: Insights from Aviation Professionals

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ABSTRACT

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This research aims towards developing a bird repellent system that can be implemented in an aircraft during take-off and landing procedures, Overcoming the limitations of the bird repellent in aircraft flights for better aviation safety, as well as seeing through how effective the bird repellent is in terms of Effectiveness, reliability and Operational Impacts. Collecting 30 respondents who have experience working within the aviation industry as pilots, engineers, Mechanics, Flight Dispatcher, or Avionics, utilizing a survey to get an understanding of the bird repellent limitations and effectiveness in terms of in-flight operations. Gathering good insight as to what is recommended for the bird repellent's overall use as well as how it should be implemented with in-flight operations. Finding proof that there are possible ways to utilize the system during in-flight operations based on the informants' suggestions.

Keywords: Bird-Repellent, In-flight, Operation, Bird Strike, Deterrent, Aircraft, Landing, Take-off.

INTRODUCTION

In-flight bird-repellent devices are an important advancement in aviation effectiveness in sunny weather, as birds might not see the laser spot clearly due to reduced contrast. Additionally, repeated use of the same laser scanning path could lead to habituation, causing birds to become accustomed to the pattern and diminishing the system's long-term effectiveness. (Chen et al., 2024).

As to the significant reduction in bird strikes, there have been major improvements in systems being effective within the airspace and airports upon use. For instance, the article itself showed results that some of their models achieved a good accuracy of 94.34% and 81.13% accuracy in detecting certain species of birds based on the data of birds they have collected. After detection, it emits a 20 kHz–25 kHz frequency that is harmless to humans and most effective with common bird species (Khan et al., 2024). Furthermore, in recent studies, they have found that flight days and non-flight days have shown a significant decline in bird population when airport noises are applied either through busy days or non-busy days (Wang et al., 2024). And in other cases, a system called the ROBIN system not only improves flight safety but also contributes to wildlife conservation efforts by reducing fatalities in bird migration patterns. Due to the implementation of the ROBIN System at the Royal Netherlands Airports, bird strike collisions have decreased by more than 50% (Kutbi, 2024). However, there is in some cases some ineffectiveness to most methods of bird repellent. The article highlights that while some bird-repellent systems, including ultrasonic and laser-based technologies, have demonstrated a reduction in bird strikes in certain scenarios, the results have not been universally conclusive. The variability in effectiveness suggests that while some systems may lead to a notable decrease in bird strikes under specific conditions, the reduction is not always statistically significant across all environments and phases of flight (Surya et al., 2020).

Aviation professionals have mixed views on in-flight bird-repellent systems, acknowledging their effectiveness in deterring birds but expressing concerns about reliability and operational integration. A qualitative study by Martin et al. (2018) examined aviation professionals' perceptions of in-flight bird-repellent systems, revealing general support for their use but highlighting concerns regarding their reliability and integration with existing safety protocols. The findings suggest that while these systems are valued, improvements are needed to enhance their effectiveness and operational compatibility within the aviation industry. In another study, the aviation industry has implemented various bird repellent systems, including sound and visual repellents, to prevent bird strikes, achieving notable effectiveness that has gathered satisfaction among aviation professionals. Despite some shortcomings that require attention, further research can enhance these systems (Rowicki et al., 2023).

Another article reviews various in-flight bird-repellent systems, such as ultrasonic and laser-based technologies, and their effectiveness in preventing bird strikes, noting that their performance can be inconsistent and often varies depending on the phase of flight, with takeoff being more effective than cruising due to environmental factors, while also highlighting issues such as technical malfunctions, maintenance challenges, and the need for frequent calibration, which can affect the overall performance and acceptance of these systems by aviation professionals. Despite the potential of these technologies to reduce bird strikes, their reliability and effectiveness need to be improved through further research and development to ensure consistent and effective bird deterrence throughout all phases of flight (Rao et al., 2020).

When it comes to the effectiveness of the bird-repellent inflight, a few studies have shown that most active bird strikes happen once the aircraft reaches cruising altitudes, or roughly 1000 meters (Metz et al., 2021). With some equipment itself upon use, an article states the use of a sound field that reduces the flight speed of birds when approaching a striking surface like a mist net. Decreasing their velocity by 20%, which helps reduce the collision of the impact force. The sound field likely draws birds' visual attention, giving them more time to react and avoid collisions. For practical applications, extending the sound field's range in real-world settings, such as near buildings or turbines, could further enhance collision avoidance. (Gehring, Kerlinger & Manville, 2015). Another effective method is ultrasonic radiation to repel birds by emitting frequencies between 20 and 30 kHz, which disturbs them without causing harm. Since ultrasound travels faster than an airplane, it can be deployed effectively just after takeoff and before landing, provided that the device generates these frequencies with sufficient power for optimal results (Rao et al., 2020).

This thesis investigates in-flight bird-repellent systems, focusing on their design, efficacy, and implementation challenges in reducing bird strikes—a significant threat to aviation safety that can cause serious damage to aircraft, endanger passengers and crew, and incur substantial financial losses. It reviews various technologies, including radar-based systems, visual deterrents, and audio devices, assessing their operational effectiveness through field tests and simulations. Additionally, the study addresses the implementation hurdles faced by airlines and regulatory bodies, such as compliance issues, costs, and integration with existing safety protocols. Ultimately, the thesis aims to enhance aviation safety through innovative solutions and highlights the need for ongoing research and development in this area.

Background of the Study

Collisions between birds and airplanes, commonly known as bird strikes, pose significant operational and safety risks in aviation. Understanding the history of bird strikes and the aviation industry's response to them provides valuable insights into current mitigation techniques and ongoing challenges. The article highlights that the first recorded bird strike in aviation history occurred in 1905 involving an early Wright Brothers aircraft. Since then, awareness of the potential threats from birds to aircraft operations has grown (International Airport Review, 2023). Initially, bird strikes were poorly understood, and the primary response was to repair the damaged aircraft and assess the damage. Over time, as the frequency and severity of bird strikes increased, the aviation industry developed increasingly sophisticated procedures to address these incidents. Early bird strike management was predominantly reactive, focusing on maintenance and repair post-event. However, with the rise in bird strike incidents, proactive measures were introduced, including the development of bird detection and monitoring systems, various deterrent devices, and habitat management strategies around airports to discourage birds.

Avian safety and operational efficiency have improved, as evidenced by advancements in bird strike

management. In the mid- to late 20th century, researchers began studying bird habits and flight patterns to develop more targeted repellents. This period saw the introduction of devices like propane cannons and pyrotechnics designed to create noise to scare birds away. Technological advancements have led to the development of more sophisticated bird repellents, including visual deterrents such as reflective tapes, lasers, and lights (El et al., 2014).

Recent advancements in bird-repellent technology emphasize eco-friendly approaches to reduce bird strikes. One notable development is using laser bird-repellent systems, such as the AVIX Autonomic Mark II, which creates the illusion of a moving object to deter birds without physical contact. This system effectively keeps birds away from specific areas. Additionally, bio-acoustic deterrents that emit distress calls and multi-sensory devices integrating visual, auditory, and olfactory stimuli enhance bird management. These innovations reflect a trend towards comprehensive bird control measures that combine habitat modifications and monitoring while minimizing environmental impact.

Visual Deterrent Systems

Technological advancements have led to the development of more sophisticated bird repellents, including visual deterrents such as reflective tapes, lasers, and lights (El et al., 2014).

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Audio Deterrent Systems

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Radar and Monitoring System

However, with the rise in bird strike incidents, proactive measures were introduced, including the development of bird detection and monitoring systems, various deterrent devices,

Habitat Management and Eco Friendly Strategies

Habitat management strategies around airports to discourage birds. Recent advancements in bird-repellent technology emphasize eco-friendly approaches to reduce bird strikes

Historical Context and Industry Response

The article highlights that the first recorded bird strike in aviation history occurred in 1905 involving an early Wright Brothers aircraft. Since then, awareness of the potential threats from birds to aircraft operations has grown (International Airport Review, 2023). Initially, bird strikes were poorly understood, and the primary response was to repair the damaged aircraft and assess the damage.

Despite these advancements, bird strikes remain a significant concern. In 2018, civilian flights in the USA reported 14,661 wildlife collisions, averaging over 40 per day. These incidents have been linked to over 106 civilian deaths globally in the past twenty years and resulted in approximately $1.2 billion in annual damage (Powers, 2019).

Building on early lessons, contemporary research, and cutting-edge technologies are now used to prevent bird strikes and mitigate their impact (International Airport Review, 2023).

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Theoretical Framework

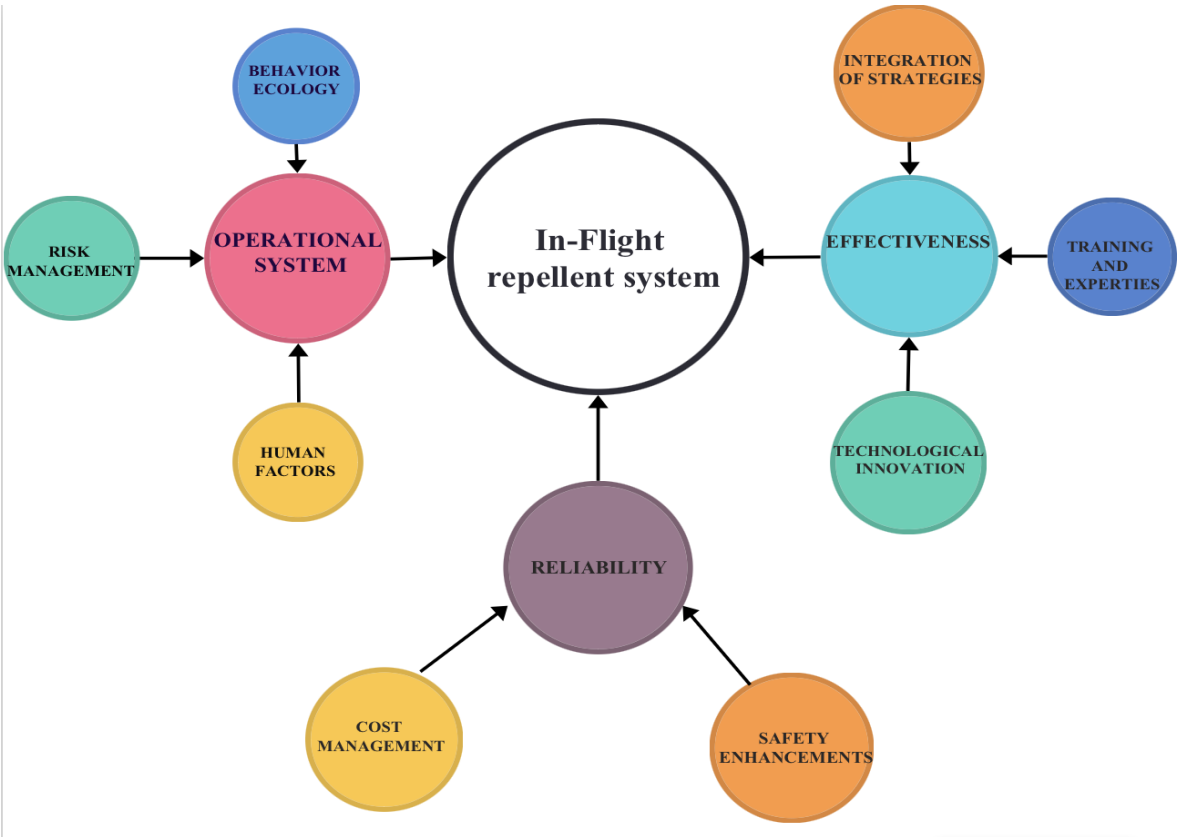

Fig. 1: In-flight Bird Repellent System

The concept map outlines the essential elements that affect the effectiveness, reliability, and operational impact of in-flight bird-repellent systems within the aviation industry. It highlights the importance of integrating multiple strategies, such as sound and visual deterrents, along with chemical repellents, that are employed to improve the overall effectiveness of these systems.

An in-flight bird-repellent system is designed to reduce the risk of bird strikes by integrating various detection and deterrent technologies into the aircraft's operational framework. These systems often use radar and optical sensors to detect birds in the vicinity, providing real-time alerts to the pilots and allowing the system to take preventive actions such as emitting high-frequency sounds, ultrasonic waves, or laser patterns to deter birds from the aircraft's path. Additionally, the system may automatically adjust the aircraft's trajectory or communicate with Air Traffic Control to enhance safety, ensuring safer flights and reducing potential damage to both aircraft and wildlife.

A reliable repellent system ensures consistent performance, minimizing disruptions and maintaining safety. Effective cost management balances the expenses of implementing and maintaining the system while ensuring it remains affordable. Improved reliability and cost-efficiency enhance overall safety by reducing the risk of failures or costly incidents. Thus, the connectivity of the framework ensures that a reliable and cost-effective repellent system contributes to greater safety, creating a cohesive loop where each element supports and enhances the others.

The effectiveness of an in-flight repellent system is enhanced through the integration of strategies, training and expertise, and technological innovation. A well-planned approach ensures that the system is tailored to specific environmental conditions and operational needs. Comprehensive training equips personnel with the knowledge to operate and troubleshoot the system effectively, maximizing its performance. Expertise in the field allows for the development of more sophisticated solutions and the fine-tuning of existing technologies. Technological innovation introduces advanced materials and methods, improving the system’s efficiency and reliability. When these elements work together harmoniously, it turns into effectiveness, and it directs to the In-flight system.

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Conceptual Framework

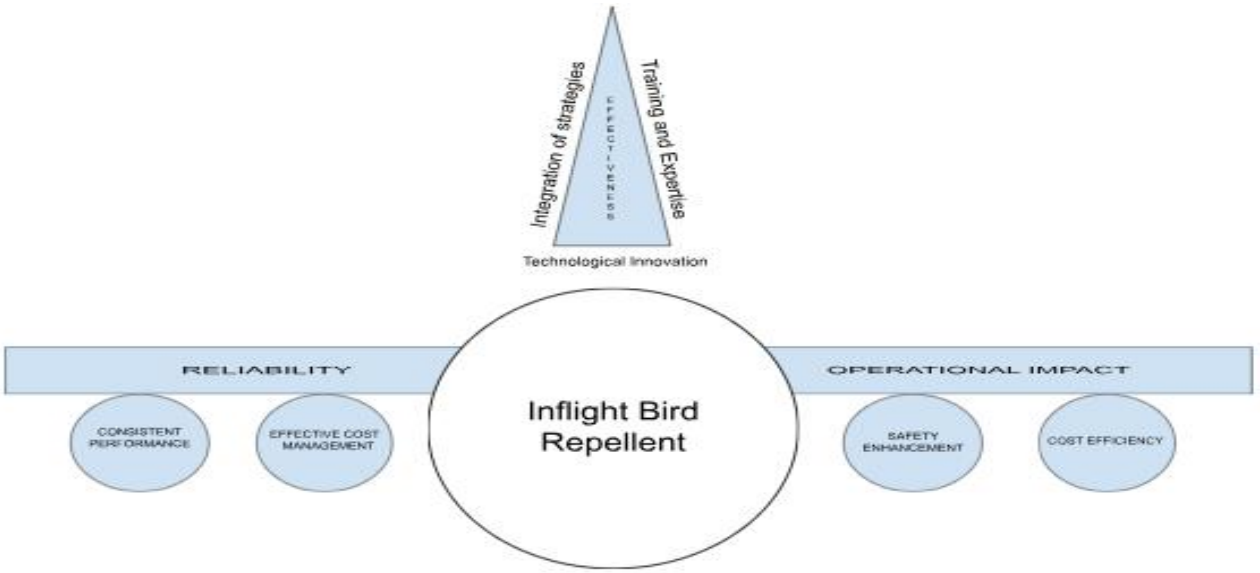

Fig. 2: Implementation of bird repellent in In-flight Operations

The effectiveness of bird repellent revolves around three criteria that make the repellent effective. Technological innovation will bring newer ways to prevent bird strikes and repel birds effectively. Tools that disrupt birds' navigation or comfort, like high-frequency sounds or flashing lights, can cause disorientation or discomfort, making the area less attractive for flying birds.

Because the performance of bird repellent systems depends on knowing bird behavior, choosing suitable deterrent techniques, and properly installing and maintaining the equipment, these systems frequently call for training and experience that is knowledgeable enough to guarantee that the repellant is suited to certain bird species and environmental circumstances, and training facilitates troubleshooting and performance optimization. Without the right data or proper training, the repellant may not work as planned.

Lastly, the integration of strategies: To fully make use of the inflight bird repellent, there will be a need for outside support from the aircraft in order for the bird repellent to be utilized more effectively; knowing when to use it and where will make the bird repellent a much more effective tool, communication from ATC to pilot about percentage of bird migration and radar detection, which goes back to technological innovation when producing newer ways to predict and repel birds, the triangle shape used helps explain how all of them connect together in order for the bird repellent to be effective.

When it comes to the operational impact, the inflight bird repellent will help mitigate any incident reports related to bird strikes, reducing cost when it comes to repair as well as preventing future bird strike-related incidents or crashes pertaining to the bird strike. Reducing entirely in maintenance and repair cost and completely preventing another bird strike-related incident.

Bird-repellent reliability revolves around physical deterrents to keep birds away from airplanes in the sky. Bird repellents can be fairly effective while in flight. However, depending on the kind of bird, the weather, and the particular surroundings of the airport, their efficacy may vary. To improve their dependability, additional techniques, training, and regular changes are frequently needed.

With that in mind, each of them that connects to the bird repellent works hand in hand with each other, as the effectiveness of the bird repellent will greatly show a reliable tool in order to fully bring safety and cost-effectiveness when it comes to in-flight operation.

The circles under the wing will constantly repeat, but the rectangle wing will remain unchanged as the operational impact will make a difference in both safety and cost efficiency. The same goes with reliability, as the bird repellent will in turn be a reliable tool for the operation.

Statement of the Problem

This study aimed to assess the effectiveness of the bird repellent system which focuses on in-flight operation.

1. What are the limitations of the current bird repellent, and how do we improve the system in the future for better aviation safety?
2. What are the impacts of the latest in-flight bird repellent with the overall bird migration after implementing the system?
3. How do aviation professionals perceive the effectiveness, reliability, and operational impact of in-flight bird-repellent systems, and what are their experiences and recommendations for improving these systems?
4. How Effective is the In-flight Bird Repellent Equipment system during the various phases?
5. How do in-flight bird-repellent systems improve aviation safety during takeoff?
6. How do these systems adapt to weather conditions and account for local flight activity levels?

Significance of the Study

This study would benefit the following:

1. Students - can receive practical insights and data for activities and assignments focused on bird-repellent systems.
2. Aviation Professionals - Aviation professionals will be able to utilize this in terms of planning operations when it comes to avoiding bird migrations as well as conducting safety operations and management.

II. Future Researchers - They will find the evaluation of in-flight bird-repellent systems important as it offers important insights into the efficiency and usefulness of these technologies in actual applications. This information can spur innovation in repellent techniques, enhancing productivity and safety in sectors impacted by bird intrusion.

METHODOLOGY

Research Design

Given the specific area of the researchers' study, the choice of the researchers' methods are limited, so the researchers' research is entirely descriptive as it aims to further research on a bird repellent that is tackling an existing system which is used in airports to an in-flight operation For the methods of the researchers' research, the researchers utilized both a questionnaire and survey that helps give the researchers the support that the researchers need to fully get a broader understanding of the researchers' bird repellent and its applications. Where it may be used effectively based on the researchers' applicant's understanding of the research. Finally, with all of the researcher's collected data, the researchers' methods will aim towards cross-tabulation given the survey the researchers have provided.

Respondents

Data collection for this study was conducted using a combination of questionnaires, surveys, and interviews. The researchers carried out two separate surveys: a pilot test, which included a total of 33 respondents, and a final survey, which also had 33 respondents. The participants in these surveys were selected from two different groups. The first group of participants consisted of students enrolled in technical courses, while the second group was made up of professionals from various sectors within the aviation industry who had expertise about bird repellents. The use of Slovin's formula was not considered essential by the researchers, as it was deemed irrelevant to the scope and objectives of the study.

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The respondents involved in the pilot testing were primarily students pursuing technical programs. These students were selected because their understanding of the subject matter, specifically related to bird repellents, was enough for the purpose of providing meaningful responses to the survey questions. Their academic background in technical fields gave them a basic understanding of aviation and related topics, which helped ensure they could engage effectively with the content of the surveys.

On the other hand, the respondents who completed the final survey were professionals with at least one year of experience in the aviation industry. This group included individuals from specialized fields such as Aircraft Mechanics, Pilots, Aeronautical Engineers, and Avionics specialists. These professionals were directly involved in the daily operations of air travel and were familiar with the details of airport procedures. Additionally, their expertise extended to understanding the importance of bird repellents in maintaining the safety and efficiency of air travel. Given their hands-on experience, these participants were not only familiar with the regulations governing bird repellents but also with their practical application in aviation environments. As a result, they were well-equipped to provide insightful and informed responses to the final survey.

Specialization	**Frequency**	**Percentage**
Aeronautical Engineer	9	27.30
Commercial Pilot	4	12.10
Private Pilot	10	30.30
Aircraft Maintenance Technician	6	18.20
Flight Dispatcher	3	9.10
Avionics	1	3.00
Total	33	100.00

Table 1: Frequency and Percent Distribution of the Specialization Bracket of the Respondents

To gather different perspectives, the researchers conducted a survey involving respondents from various professions within the aviation industry. These included Aeronautical Engineers, Commercial and Private Pilots, Aircraft Maintenance Technicians, Flight Dispatchers, and Avionics specialists. This approach ensured a well-rounded understanding of the subject by incorporating insights from professionals with different roles and expertise in the field. The profession with the highest participation in the survey is Private Pilot, which makes up for 30.3% of the total respondents. On the other hand, the profession with the lowest participation is Avionics, making up only 3.0%. This shows a varied representation of professionals from different fields within the aviation industry.

Age	**Frequency**	**Percentage**
Up to 30 years old	24	72.00
31 - 40 years old	4	12.10
41 - 50 years old	3	9.10
Over 50 years old	2	6.10
Total	33	100.00

Table 2: Frequency and Percent Distribution of the Age Bracket of the Respondents

The researchers also made sure to get the age and their working experience to determine their knowledge when

it comes to the topic. The survey data on age indicates that the majority of respondents (72%) are up to 30 years old, representing a relatively younger group. The next largest group is individuals aged between 31 and 40 years, making up 12.1% of the respondents. Those in the 41-50 years age group make up 9.1%, while the smallest group, those over 50 years old, make up 6.1% of the total participants.

Work Experience	Frequency	Percentage
Less than 1 year	10	30.30
1 - 5 years	14	42.40
6 - 10 years	3	9.10
More than 10 years	6	18.20
Total	33	100

Table 3: Frequency and Percent Distribution of the Work Experience Bracket of the Respondents

When it comes to work experience, the largest portion of respondents (42.4%) have 1 to 5 years of experience, suggesting they are still in the early stages of their careers. The second-largest group (30.3%) has less than 1 year of experience. Meanwhile, 18.2% of respondents have more than 10 years of experience, indicating they are more experienced, and 9.1% have 6 to 10 years of experience. Overall, the total number of respondents in both categories is 33.

Settings

The survey provided tackles around the reliability of the bird repellent, using a Qualitative and Quantitative survey method, categorized by (1) Highly Disagree (2) disagree (3) Agree (4) Highly Agree, as a quantitative measure of understanding of the researchers' respondents' views. The researchers also analyzed the majority of the respondents' views to see if there are any patterns in their understanding of what the researchers are researching and how reliable the research is in future context.

The scope of this research on bird repellents, targeting professionals in the aviation industry such as pilots, mechanics, and engineers, focuses on identifying effective bird deterrent technologies and evaluating their insights when it comes to the application of in-flight bird-deterrent effectiveness and maintenance operations. Limitations of the study include regional variations in bird behavior, potential unforeseen effects on aircraft systems, and a limited number of respondents due to the complexity of the study, as the research focuses on professionals who have an idea on the application of in-flight bird repellents. With current limitations of our study. The physical test and experimentations cannot be done as the research aims to create a concept of the in-flight bird repellent and are unable to provide a solid basis for the bird repellent system, this is mainly to further enhance future research in the creation of a physical in-flight bird repellent. The findings are heavily reliant on their insights and practical experience with current bird repellents used in airports.

The survey was conducted on-site at the company, with participants completing the questionnaire in a well-ventilated room equipped with emergency exits. The environment was carefully selected to ensure the smooth execution of the survey.

Instrumentation

Research success, especially in aviation safety, depends on developing good questions and objectives. The research, "Assessment of Bird Repellent Equipment in Aviation: A Focus on In-flight System," underlines the significance of accurate data collection and analysis. The technique included collaboration with three aviation professionals: a maintenance department head, a commercial pilot and professor, and a flight dispatcher who contributed useful insights to help improve the study instruments. The initial contact was made via formal emails, followed by in-person meetings to outline the study's objectives and request their expertise.

Their inputs improved the survey instrument, making it clearer and more relevant. Each validator formally endorsed the completed paper, assuring accountability and integrity throughout the study process.

The study focuses on four main areas: the limits of present bird repellents, statistical analysis of bird attacks, aviation experts' perceptions on effectiveness and dependability, and the efficacy of in-flight bird repellent systems throughout different flight phases. The study collects data via a Google Forms questionnaire, emphasizing the relevance of expert comments in increasing the research's legitimacy and effect.

In regard to the researchers' interview questions, the main idea of it comes from the Statement of the Problem that the researchers are looking into, basing it on its relevance, Summarizing the Statement of the problem and creating questions that best fit what the researchers are trying to look into, Validating the question to a professional.

Data Analysis

The researchers employed weighted mean and thematic analysis to analyze the effectiveness of bird repellent equipment in aviation, focusing specifically on in-flight systems. Given the specific scope of the research, the choice of methods was limited, resulting in an entirely descriptive approach aimed at addressing existing bird repellent systems used in airports and their application in-flight. To gather comprehensive data, the researchers utilized both questionnaires and surveys, which provided essential insights into user experiences and perceptions of the equipment. By creating contingency tables, the researchers examined relationships between categorical variables such as effectiveness, reliability, and operational impacts. This analysis enabled the identification of trends and patterns, revealing that bird repellent equipment systems were perceived as more effective and providing valuable insights for improving bird hazard management in aviation.

Ethical Considerations

The research team ensures that personal information is kept private. The surveys used to obtain the necessary data for the study were conducted in adherence to established guidelines, maintaining participant confidentiality. Participants were not hindered in their daily lives and were informed that their involvement in the study would remain private and confidential. Compliance with data protection legislation, such as the Data Privacy Act of 2012, is crucial for ensuring that all information is collected and stored securely. The research team will disclose to participants what data is being gathered and how it will be used. To comply with protocols, permission and consent from the organization or firm will be secured prior to commencing the research. Furthermore, a representative will be present to assist in coordination and oversight during the study.

The research team guarantees that all parties involved will operate in a secure environment, adhering strictly to site safety protocols established by Aviation School regulations. To ensure the comfort and well-being of all researchers and participants, meals will be provided if the activity extends beyond regular business hours. Participants are allowed to decline participation in the study at any time, making participation completely voluntary. It is recognized that sensitive issues may arise during the research, and the study may explore topics that some individuals may find uncomfortable. The research team is committed to conducting the study in a manner that minimizes risk to the organization while maintaining integrity and confidentiality at all times.

Appropriate support mechanisms will be in place to address any concerns that may emerge throughout the research process, acknowledging the potential for emotional difficulty. Meetings and discussions with participants will take place in well-lit locations to foster a relaxed atmosphere. The research team prioritizes safety by ensuring that emergency and safety exits are clearly marked and easily accessible. To further reduce potential health and safety risks, the team will avoid conducting research in areas with high hazards, such as those impacted by engine emissions, fuel spills, noise pollution, or other industrial dangers.

A plan for potential safety issues had been established before any research activity began, including protocols for when to evacuate an area if necessary. The research team will encourage participants to refrain from bringing valuables or large sums of cash, as this not only minimizes the temptation for theft but also helps maintain focus on research objectives. A safer research environment is largely achieved through organization and caution.

Maintaining communication with the organization's representative during research activities is essential for ensuring smooth operations and addressing any emerging concerns. Regular contact helps keep all parties informed and allows for prompt responses to unforeseen circumstances. Coordination with the school clinic or security can provide an additional layer of safety, ensuring immediate assistance is available if needed. Open lines of communication with participants are also vital, as they foster trust and enable real-time feedback, ultimately enhancing the research experience and outcomes.

Regarding the social impacts of the research team's presence, it is important to consider how the activities might affect the daily operations of the organization or institution. If the research requires significant interaction with staff or resources, it could disrupt regular workflows. However, if managed carefully, the research can yield valuable insights that assist the organization in better understanding its operations. This collaborative approach minimizes disruption while ensuring that the findings are relevant and beneficial, ultimately aiding the organization in enhancing its practices and decision-making processes.

RESULT AND ANALYSIS

The limitations of the current bird repellent, and ways to improve the system in the future for better aviation safety.

Statement	Standard Deviation	Weighted Mean	Remarks
The limitations of current bird repellents are based on the environment and its operation.	0.48461	3.21	Agree
The current bird-repellent system can be improved by enhancing their effectiveness and addressing reliability issues.	0.49620	3.61	Strongly Agree
Current bird repellents can adapt to various environmental conditions, such as natural light or foggy and cloudy weather, enhancing their effectiveness.	0.66714	3.15	Agree
Aviation safety can be enhanced by improving the bird-repellent system, especially during Landing and Take-off.	0.46669	3.70	Strongly Agree
With Current bird repellents, there are opportunities to further enhance the effectiveness against certain bird species.	0.60302	3.36	Agree
Total	0.543532	3.41	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 4: The limitations of the current bird repellent, and ways to improve the system in the future for better aviation safety.

This section presents the statistical findings on the limitations of current bird repellents and possible future improvements to enhance aviation safety. The researchers aim to assess the significance of these limitations based on the expertise of aviation professionals. Following data collection, the table indicates that the standard

deviation ranges between 0.46669 and 0.66714, with the highest deviation observed in statement 3. The weighted means across statements are relatively close in range, with four responses falling in the "Agree" category and one response in the "Strongly Agree" category.

The total value of the weighted mean in the table is 3.41, suggesting that aviation professionals generally "Agree" with the statements regarding current bird repellent systems but recognize the necessity for improvements. The variability in effectiveness indicates that while some systems can significantly reduce bird strikes, this effectiveness can be heavily influenced by environmental factors (El et al., 2014). For instance, Metz et al. (2020) discuss the challenges posed by bird strikes and how limitations in current bird control measures are exacerbated by different operational environments. To enhance the effectiveness and reliability of bird repellents, advancements in technology are essential. Chen et al. (2024) explore the potential of an automatic wild bird repellent system that utilizes deep-learning-based detection and laser rotation mechanisms, which could improve responsiveness to bird threats.

The application of in-flight bird repellent results in a statistically significant reduction in bird strikes compared to the existing system.

Statement	Standard Deviation	Weighted Mean	Remarks
Reductions of bird strikes are effective based on how accurate the detection system of birds is during the migration season within the area.	0.59512	3.33	Agree
Statistical analysis shows that using ultrasonic waves and flashing lights is more effective by a significant margin compared to existing bird-repellent systems.	0.57406	3.27	Agree
The statistical analysis revealed that bird repellent trials and testing successfully identified bird population trends in the area under various environmental conditions and applications.	0.58387	3.18	Agree
The reduced bird strike is heavily dependent on the number of flight operations happening in the area.	0.78093	3.12	Agree
Bird-repellent systems showed a significant amount of reduction when it came to the use of pulsing light systems.	0.64988	3.12	Agree
Total	0.63677	3.20	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 5: The application of in-flight bird repellent results in a statistically significant reduction in bird strikes compared to the existing system.

This section represents the statistical results of the in-flight bird repellent system's effectiveness in reducing bird strikes compared to the existing system. The researchers aimed to determine the significance of the impact of in-flight bird repellent based on the expertise of aviation professionals. After data collection, Table 2 shows that the standard deviation ranges from 0.57407 to 0.78093, with statement 4 having the highest standard deviation. The weighted means of the statements are close in range, and all responses fall within the ''Agree" category.

The total value of weighted mean in the table is 3.20, which means that the aviation professionals "Agree" to the

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statements but not strongly agree since it also needs some improvements. The variability in effectiveness notes that some systems lead to a notable decrease in bird strikes, the reduction however is not statistically significant in some environments and phases of flights (Surya et al., 2020). Systems like ultrasonic waves and flashing lights are more effective than some existing in-flight bird repellent systems (Wang, J., et al., 2024). In some bird repellent systems, testing of new systems shows improvements in detecting common bird species under various environmental conditions (Khan & Shin, n.d.). The pulsing light system shows bird strike reduction when it was used in some airlines (Metz, et al., 2020). The table results showed that the aviation professionals are agreeing of the effectiveness of the in-flight bird repellent systems compared to the existing system.

The application of in-flight bird repellent results in a statistically significant reduction in bird strikes compared to the existing system.

a.) Effectiveness

Statement	Standard Deviation	Weighted Mean	Remarks
Sound and visual deterrents used in bird-repellent systems are generally effective in deterring birds.	0.50189	3.4242	Agree
Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff.	0.49620	3.3939	Agree
The strong sound field is highly effective, according to aviation professionals, in lowering bird flying speed and increasing safety.	0.54530	3.2121	Agree
The operational safety of aviation with regard to bird strikes can be enhanced through effective in flight bird-repellent	0.62614	3.2727	Agree
The effectiveness of current bird repellent systems, such as sound and visual repellents, in preventing aircraft collisions is satisfactory.	0.57406	3.2727	Agree
Total	0.548718	3.31512	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 6: The application of in-flight bird repellent results in a statistically significant reduction in bird strikes compared to the existing system in terms of effectiveness.

The following assertions with effectiveness, in which summarize major results about the efficiency of in-flight bird-repellent systems as perceived by aviation professionals. The statistics show a widespread consensus on the effectiveness of sound and visual deterrents in reducing bird strikes. Aviation experts believe that these devices are most effective during key periods of flight, like takeoff, where bird strikes are most likely.

Specifically, the intense sound field created by these devices is extremely successful in lowering bird flying speed, hence increasing safety. Furthermore, experts feel that better integration of bird-repellent devices during

in-flight operations can considerably enhance overall aviation safety. In terms of overall efficacy, existing bird-repellent methods, such as sound and visual deterrents, are regarded as adequate for averting collisions between birds and airplanes.

The survey data shows that respondents had varying opinions on bird repellents' effectiveness, with a standard deviation of 0.5487, indicating diverse perspectives. However, the weighted mean of 3.1312 suggests that most respondents "agree" with statements supporting bird repellents' effectiveness. In aviation, measures such as sound and visual repellents are already in use to reduce bird-related collisions, and studies (Rowicki et al., 2023; Zhao et al., 2021) confirm that these methods are effective, especially when integrated more fully into flight operations.

b.) Reliability

Statement	Standard Deviation	Weighted Mean	Remarks
.The technology consistently performs well, providing accurate information about bird activity.	0.46466	3.1818	Agree
The maintenance of bird-repellent systems is dependable, with few technical malfunctions and minimal maintenance issues.	0.58387	3.1818	Agree
The rotating speaker feature of the improved system ensures uniform sound distribution, making it more reliable.	0.63066	3.0909	Agree
Maintenance requirements for the bird-repellent system are minimal and straightforward.	0.52223	3.0909	Agree
The current bird-repellent systems, including sound and visual repellents, are dependable and successfully prevent aircraft collisions.	0.59987	3.2121	Agree
Total	0.560258	3.1515	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 7: The application of in-flight bird repellent results in a statistically significant reduction in bird strikes compared to the existing system in terms of reliability.

Regarding the reliability of the in-flight bird-repellent, it shows the representation of aviation professionals' opinions on the dependability and performance of bird-repellent systems. Overall, the findings indicate that these systems are very successful and reliable. Respondents believe the system consistently offers reliable information on bird activity. Similarly, maintenance of these systems is deemed trustworthy, with few technical faults or upkeep necessary.

Key characteristics, such as the spinning speaker in enhanced systems, are praised for guaranteeing consistent sound dispersion and therefore increasing dependability. Furthermore, the ease of use and reliability of contemporary sound and visual repellents contribute to their success in averting bird strikes, with participants ranking these systems as consistently helpful in safeguarding aircraft.

The survey data shows variability in responses regarding bird repellents' reliability, with a standard deviation range from 0.4647 to 0.6361, indicating differing views. However, the weighted mean of 3.1515 reflects that most respondents "agree" on the reliability of these systems. Bird repellents' reliability is crucial for effective in-flight use against bird strikes, though technical issues like malfunctions and maintenance needs impact their acceptance and usability (Surya, 2020). Addressing human factors in the design is essential to enhance system performance and manage these operational complexities effectively (Zhao et al., 2021).

c.) Operational Impacts

Statement	Standard Deviation	Weighted Mean	Decision
The addition of bird-repellent technology has led to fewer disruptions and smoother airport operations.	0.65279	3.3636	Agree
The bird-repellent systems have manageable calibration requirements and a favorable operational impact.	0.62614	3.2727	Agree
The improved bird deterrent system integrates well with current airport operations and protocols.	0.54530	3.2121	Agree
The bird-repellent system has a positive impact on overall flight safety and efficiency.	0.55562	3.3939	Agree
The sound and visual bird repellents significantly reduce bird-aircraft collisions, and many aviation professionals are generally satisfied with their performance.	0.63663	3.3030	Agree
Total	0.603296	3.30906	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 8: The application of in-flight bird repellent results in a statistically significant reduction in bird strikes compared to the existing system in terms of operational impacts.

The following assertions regarding operational impacts, in which emphasize the benefits of bird-repellent systems on airport operations and aviation safety. Respondents believe that the inclusion of bird-repellent equipment has reduced disturbances, resulting in easier airport operations. The systems are also known for their reasonable calibration needs and small yet positive influence on everyday operations.

The integration of upgraded bird deterrent technologies into current airport processes has proven smooth, increasing their efficacy. Aviation experts feel that these devices greatly increase overall flight safety and efficiency, with sound and visual repellents playing an important role in decreasing bird-aircraft accidents. Overall, there is high satisfaction with the performance of these systems in the aviation business.

The survey results indicate varied opinions on the operational impacts of bird repellents, with a standard deviation range from 0.5556 to 0.6528, revealing differences in respondent views. However, a majority of respondents "agree" on the statements regarding operational impacts, reflected in a weighted mean of 3.3069. Aviation professionals generally support the use of bird repellents, acknowledging their effectiveness, but

express concerns about reliability and the need for better integration into aviation safety protocols (Martin et al., 2018).

The Effectiveness of the In-flight Bird Repellent Equipment system during the various phases.

Statement	Standard Deviation	Weighted Mean	Remarks
Light related bird repellent showed significant effect in reducing the number of birds and the time for birds to flee the area.	0.59987	3.12	Agree
The in-flight-bird repellent equipment effectively reduces bird flight speed and collision force within the take off phase.	0.66714	3.15	Agree
The use of radar systems has been effective in detecting birds and reducing bird strikes.	0.52944	3.30	Agree
The ultrasonic frequencies are effective in repelling birds during the landing and takeoff phases of flight.	0.45227	3.27	Agree
Total	0.56218	3.21	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 9: The Effectiveness of the In-flight Bird Repellent Equipment system during the various phase such as take-off and landing

This section presents the statistical findings on the effectiveness of the in-flight bird repellent equipment system during the various phases. The researchers aim to evaluate the significance of the effectiveness of in-flight bird repellent based on the expertise of aviation professionals. In the data collection, the table indicates that the standard deviation ranges between 0.45227 and 0.66714, with the highest deviation observed in statement 2. The weighted means across statements are relatively close in range, with four responses falling in the “Agree” category.

The total value of the weighted mean in the table is 3.21, suggesting that aviation professionals generally “Agree” with the statements but recognize the necessity for improvements. The variability in effectiveness indicates that the implementation of various in-flight bird repellent technologies, including light-related systems, radar detection, and ultrasonic frequencies, has proven effective in significantly reducing bird presence, flight speed, and collision risks during critical phases of aviation such as takeoff and landing (Rao, N., & Kumar, P. et al., 2020).In This system utilizes ultrasonic sensors to detect birds Upon detection, it emits high-frequency sounds that are inaudible to humans but disturbing to birds, effectively repelling them during critical flight phases like takeoff and landing (Surya et al. 2020). The results from the table indicated that aviation professionals agreed on the effectiveness of in-flight bird repellent systems in various phases of flight.

In-flight bird-repellent systems improve aviation safety by reducing bird strikes during takeoff, adapting to various weather conditions, and decreasing collision force.

Master Theme	Superordinate Themes
• The reduced bird strike is heavily dependent on the number of flight operations happening in the area.	Reduction
• Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff.	System Improvements

Table 10: Master Themes and related Superordinate Themes on the in-flight bird-repellent systems improve aviation safety by reducing bird strikes during takeoff, adapting to various weather conditions, and decreasing collision force.

Master Theme 1: The reduced bird strike is heavily dependent on the number of flight operations happening in the area.

Superordinate Theme 1: Reduction

Informant 2: . ‘’However, it would have reduced the bird strike that would happen in the airport. And that's the purpose of the bird repellent.’’

Informant 3: Then, if that happens you will not have visuals anymore, so I think it much better if let's start here for example in the Philippines in all airports, they should implement a machine that would repel birds, especially to the starting pilots in Gen Av. It would have a reduction when it comes to the strike.

Informant 3 emphasizes that for the bird repellent to be effective, it should be first implemented in the Philippines so it can be tested. It could initially be used in general aviation, where small aircrafts are operated. Both visual and sound repellents are expected to reduce the bird strikes. The master themes detailed that when it comes to preventing hazards of bird strikes, effectiveness plays a pivotal role to overcome these challenges while thoroughly addressing the correlation of answers between the informants, all are intensified in the same idea. The data gathered shows that when it comes to effectiveness it is not 100% accurately reliable or effective since the researchers were used to frequency and not all bird species will be deterred however, it would lessen the bird strikes in such flight operations. Thus, common answers of the informants that use frequency as bird deterrent are not that precise or accurate in preventing birds from the aircraft. Statistical analyses in the studies indicate that, although there are instances where bird strikes have been significantly reduced, the overall evidence does not consistently show a statistically significant reduction across all applications and conditions (Surya et al., 2020).

Master Theme 2: Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff.

Superordinate Theme 2: Systems Improvements

Informant 3: Overall Improvements, Maybe if it’s already implemented, and it's doing a good job already, I’d say minor revision instead. Especially with the weather. For example, The researchers can’t really say that the weather could affect the operations of the actual system. Yeah that’s it.

Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff. The theme discusses and highlights the need to improve the effectiveness of bird-repellent systems during takeoff and landing, as indicated by the informants' responses. The data suggests that overall

enhancements and minor revisions to the system, particularly in its operations, are the key solutions for improving bird-repellent effectiveness. To improve reliability, the guide recommends continued research to enhance system performance in adverse weather, better adaptability to diverse ecosystems and bird species, and integration with other wildlife management practices. (Rao & Kumar, 2020).

Their effectiveness also depends on local flight activity levels.

Master Theme	Superordinate Themes
• Current bird repellents can adapt to various environmental conditions, such as natural light or foggy and cloudy weather, enhancing their effectiveness.	Application
• The operational safety of aviation with regard to bird strikes can be enhanced through effective in-flight bird-repellent.	Innovate
• The in-flight-bird repellent equipment effectively reduces bird flight speed and collision force within the take-off phase.	Efficacy

Table 11: Master Themes and related Superordinate Themes on their effectiveness also depends on local flight activity levels.

Master Theme 3: Current bird repellents can adapt to various environmental conditions, such as natural light or foggy and cloudy weather, enhancing their effectiveness.

Superordinate Theme 3: Application of Bird Repellent

Informant 1: ‘’We have the existing, bird-repellent installed in the different airports, just to stay away from this type of incident.’’

The theme discusses that the application of current bird repellent is effective in chasing away birds that migrate in the area from the airport. There is no working bird repellent when it comes to flight and the only known bird repellent is within the airport vicinity. From the informant, some airports already used bird repellent to avoid bird strikes. If airports can prevent bird strikes, a bird repellent installed in an aircraft can also be effective. According to the application of bird repellent in different areas, the airport can take corresponding measures to prevent bird strikes (Wang, J., et al., 2024).

Master Theme 4: The operational safety of aviation with regard to bird strikes can be enhanced through effective in-flight bird-repellent.

Superordinate Theme 4: Innovate

Informant 1: ‘’Now, the challenge uh for the in-flight repellent installed in the aircraft because this repellent it depends upon the component on mechanism.’’

Informant 2: ‘’Maybe the solution is to make a stronger frequency…’’

According to the informants, adjusting the repellent mechanisms, such as using stronger frequencies or visual deterrents, can further improve the effectiveness of bird repellents against different bird species, enhancing their ability to reduce bird strikes during flight. However, the effectiveness of attaching bird repellents to an aircraft largely depends on the specific technology and mechanism used, as not all systems work well for every bird species. This variability means that the success rate of these repellents can differ widely, and no single solution guarantees complete protection every flight.

To improve the effectiveness, reliability, and operational impact of bird-repellent systems, innovations must take place when implementing them in-flight. The bird repellent systems are effective at some airports according to the data, but when applied to aircraft, the shortcomings of the current bird repellents must be addressed. The challenges for innovation are complex, but it is essential for the systems to be both effective and reliable. Aviation professionals are in support when using these systems but the need to integrate them with the existing safety protocols to increase reliability is a concern to them (Martin et al., 2018).

Master Theme 5: The in-flight-bird repellent equipment effectively reduces bird flight speed and collision force within the take-off phase.

The theme discusses the in-flight-bird repellent equipment and its effectiveness in reducing bird flight speed and collision force within the take-off phase. Using Ultrasonic sound waves and laser emitters mounted on the aircraft to repel birds during take-off phase and one of the most critical phases. These repellents emit frequencies and light patterns that disrupt birds vision and behavior, causing them to slow down, change course or the best part is to stop mid-flight to avoid the aircraft. (Rao, N., & Kumar, P. et al., 2020)

Superordinate Theme 5: Efficacy

Informant 1: ‘’Well, according to the study, it's very effective.’’

Informant 3: ‘’...if I'm going base it from the Heathrow, the one I mentioned a while ago, it is 100% effective…’’

The studies discussed show that the bird repellent systems are able to produce the desired results and are effective. In the informants' responses, they agreed that the bird repellent is effective in preventing bird strikes at airports. Birds may strike at various phases of flight but the most critical is take-off. The bird repellent in an airport is effective, it can travel faster than the speed of the airplane and it can be used to repel the birds just after take-off (Rao, N., et al., 2020).

DISCUSSION

Conclusions

Based on the results and analysis, the following were concluded:

The majority of the respondents agree that the bird repellents, based on frequency, lights, and sounds are effective in chasing away birds. About the bird-repellent limitations. The majority of the respondents strongly agreed and agreed that the system can be further improved to overcome natural occurrences like environmental factors during take-off and landing procedures of the aircraft when protecting or preventing bird strikes. Furthermore, with current bird-repellent systems, Respondents also agreed that the reduction of bird strikes is based on how accurately the detection system works on bird species, additionally same goes for its effectiveness as almost all the respondents Agreed that the bird population in an area decreased when exposed to sound deterrents and light deterrents.

With the occurrence of bird strikes, Aircrafts lack the necessary precautions in order to prevent any sort of damage to the aircraft, however with newer systems being developed in the future, The Researchers can provide newer ways to prevent bird strikes. Bird repellents for aircraft should utilize both sound and light deterrents that disrupt bird migrations trajectory towards the aircraft and hopefully stand clear of the aircrafts path. With the idea of using radar detection systems to detect birds from a far distance in order for pilots and/or co-pilots to take precautionary measures in order to utilize the bird repellent. With implemented bird repellent systems, there will be a need of operational training in order to utilize the bird repellent to its optimum potential so that the system is used effectively in order to avoid misuse.

Aviation professionals agreed on the effectiveness of sound and visual deterrents in reducing bird strikes and they also agree on the reliability of In-flight bird-repellent which provide accurate information on bird activity, particularly during various phases. While these systems are recognized for reducing birds, there is also a need for better integration and addressing technical concerns to improve their overall effectiveness.

Aviation professionals agreed on the effectiveness of in-flight bird-repellent systems during critical phases like take-off and landing. Technologies like ultrasonic sensors effectively reduce birds and collisions, but there is a need for improvement to enhance their overall efficiency.

Aviation professionals concurred with the same idea in regard to reduction of bird strike using the bird repellent system during take-off and landing phases. In addition, the bird repellent system is really effective in deterring different species of bird; however, the system itself needs further development to become more effective and accurate.

The application of bird repellent is effective when it comes to adapting in different environmental conditions. On the other hand, the operational safety of aviation can be established and enhanced through the effectiveness of in-flight bird repellent. Lastly, it is said that the in-flight bird repellent can reduce the chances of collision and reduces the bird flight speed within the take-off space.

	Advantages	Drawback
Visual Deterrents	● Cheaper than other deterrent and Easier to deploy. ● Can minimally set up cover over large areas. ● Environmentally Friendly and Nonlethal. ● This approach can combine with other ones. ● It provides instant deterrent upon first presentation	● Birds swiftly adapt and learn to ignore static visuals. ● Limited efficacy in low-light or foggy conditions ● Some visual tools or equipment (such as lasers) may endanger pilots if misused ● To maintain effectiveness, it must be repositioned or updated on a regular basis. ● Less Effective against optically adapted birds.
Sound Deterrents	● Minimized collateral damage in terms of use. ● This system doesn't harm the wildlife. ● Advanced sound deterrents can emit species-specific distress calls. ● Reduce bird strike.	● Sound Disperses quickly in an open environment. ● Birds can become accustomed to repeated sound patterns. ● High-volume or distressing sounds might disrupt airport operation. ● Not all bird species respond the same way to sound deterrent. ● Installing and maintaining sound systems adds wight, cost and complexity

Recommendations

Based on the discussed conclusions, the recommendations are as follows:

1. Improve systems for environmental factors: Improving bird repellent systems to automatic should adapt to weather conditions during take-off and landing. Increase Real-time Adaptability: Design a system that can adjust deterrents based on bird behavioral factors and also to different environments.

2. Combine Deterrent Methods: Use sound, light ,and frequency deterrents to create a more effective multi-sensory deterrent system.

3. Keep them Well-maintained: Develop a Structure for the maintenance of deterrent systems for sustainable goals.

4. Conduct extended research: Studies for a prolonged period on the effectiveness of deterrents on a population of birds.

5. Upgrade the Detection Technology: Investing in more sophisticated detection technology to better identify different types of bird species which can prevent a bird strike.

6. Broaden Assessment Across Species: Text systems on a larger number of bird species to confirm broad effectiveness and to have a pilot program at airports: Implement a pilot program at airports to test new bird repellent systems in real-world condition.

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APPENDIX

Appendix A*:* RRL Matrix

Related Literature Study	**Statement of Problem 1:**	**Statements in the survey questionnaire**
1. Key issues such as inconsistent effectiveness in deterring birds, reliability problems that can affect system performance and operational challenges that make the systems difficult to use in real-world settings. (Surya, M., Rao, N. L., Pratham Kumar, D., & BR, M. S. K. (2020).) 2 The limitation of current-bird repellent systems used in aviation, focusing on issues such as inconsistent effectiveness, reliability problems, and operational challenges (Kumar, 2020). 3. The bird repellent system may lose effectiveness in sunny weather, as birds might not see the laser spot clearly due to reduced contrast.Chen, Y. C., Chu, J. F., Hsieh, K. W., Lin, T. H., Chang, P. Z., & Tsai, Y. C. (2024)	What are the limitations of the current bird repellent and how do we improve the system for aviation safety	Q1. The limitations of current bird repellents are based on the environment and its operation. Q2. The current bird-repellent systems can be improved by means of enhancing their effectiveness and addressing reliability issues. *Q3. Certain bird repellent faces issues when it comes to environmental factors in contrast with: Natural light, Foggy and cloudy weather *Q4. Aviation safety can be enhanced by improving the bird-repellent system, especially during flight. Q5. With current bird repellent there are certain limitations with its effectiveness against certain bird species.

4. A study by Blackwell et al. (2016) examines the limitations of current bird-repellent systems, such as the limited effectiveness of acoustic deterrents and the habituation of birds to visual deterrents. 5. High frequency bird repellents are limited towards the level of birds ability to hear certain frequencies. Jenitha, V., Niranjanadevi, V., Rajashree, R., & Jeevitha, S. (2021).		
Related Literature Study	**Statement of Problem 2:**	**Statements in the survey questionnaire**
1. Reducing the bird strikes heavily relies on how an accurate bird repellent system can detect nearby birds close within the area. Khan, F. A., & Shin, S. Y. (2024) 2. Various bird-repellent systems and their effectiveness in reducing bird strikes results from studies and trials, noting that while some technologies like ultrasonic and laser-based systems. The overall evidence does not consistently demonstrate a statistically significant reduction in bird strikes across different conditions and applications (Rao, 2020). 3. According to the article, while some systems, such as ultrasonic and laser-based technologies, have shown potential in reducing bird strikes, the results across different trials have been mixed which are dependent on conditions and application. Surya, M., Rao, N. L., Pratham Kumar, D., & BR, M. S. K. (2020). 4.As per the article's findings, they have stated that most of the birds found within the area of the airport showed a significant amount of decrease as per busy flight day then non flight days, indicating the effectiveness of sound that affects bird population in certain areas. Wang, J., Liu, W., Lin, Q., & Hou, J. (2024). 5. Alaska Airlines has experienced a 33.5% reduction in bird strikes over three years. For Qantas Airways, comparing aircraft with and without the pulsing system has resulted in a reduction in bird	Compared to the existing system, is there a statistically significant reduction in bird strikes after applying in-flight bird repellent?	Q1. Reductions of bird strike are effective based on how accurate the detection system of birds within the area. Q2. Statistical analysis shows that in-flight bird-repellent systems reduce bird strikes by a significant margin compared to the existing bird-repellent system. *Q3. The statistical analysis showed bird repellent trials and testing provided mix results when conditioned to certain conditions and applications Q4. The reduced bird strike is heavily dependent on the number of flight operations happening in the area. Q5. Bird repellent systems showed a significant amount of reduction when it came to the use of pulsing light systems.

strikes of between 54% and 66 for the past 2 years. Metz, I. C., Ellerbroek, J., Mühlhausen, T., Kügler, D., & Hoekstra, J. M. (2020).		
Related Literature Study	**Statement of Problem 3:** What are the aviation professionals' perceptions in terms of:	**Statements in the survey questionnaire**
1.The literature highlights the varied effectiveness and reliability of bird-repellent systems in aviation, such as avian radar, which is useful for detecting and assessing bird-strike risks but can lose effectiveness as birds adapt. Challenges include false alarms, weather sensitivity, and the need for human intervention. While these systems enhance safety, they introduce operational complexities like maintenance demands. Emphasizing human factors in system design is crucial to improve performance and manage these impacts effectively. (Zhao et al 2021). 2. Aviation professionals note that these systems exhibit inconsistent performance, being more effective during takeoff and less so during cruising due to environmental factors. The reliability of these systems, including issues like technical malfunctions, maintenance needs, and frequent calibration, significantly influences their acceptance (Surya, 2020). 3. The study found that an intense sound field reduces birds' flight speed by about 20% and changes their posture, lowering collision impact forces and enhancing safety. It also improves visual attention and reaction time. Extending this sound field's range in practical settings could further boost collision avoidance. (Hong et al., 2019). 4. A qualitative study by Martin et al. (2018) explored the perceptions of aviation professionals regarding the effectiveness, reliability, and operational impact of in-flight bird-repellent systems. The findings indicate that while there is	A. Effectiveness	Q1. Sound and visual deterrents used in bird-repellent systems are generally effective in deterring birds. Q2. Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff. Q3.The strong sound field is highly effective, according to aviation professionals, in lowering bird flying speed and increasing safety. Q4. The operational safety of aviation with regard to bird strikes can be enhanced through effective in flight bird-repellent Q5. The effectiveness of current bird repellent systems, such as sound and visual repellents, in preventing aircraft collisions is satisfactory.
	B. Reliability	Q1.The technology consistently performs well, providing accurate information about bird activity. Q2. The maintenance of bird-repellent systems is dependable, with few technical malfunctions and minimal maintenance issues. Q3. The rotating speaker feature of the improved system ensures uniform sound distribution, making it more reliable. Q4. Maintenance requirements for the bird-repellent system are minimal and straightforward. Q5. The current bird-repellent systems, including sound and visual repellents, are dependable and successfully

general support for using these systems, concerns exist about their reliability and the need for better integration with existing aviation safety protocols. 5. The aviation industry has implemented various bird repellent systems to prevent collisions between birds and aircraft. Systems like sound and visual repellents have proven effective, and many aviation professionals are generally pleased with their performance. However, there are some shortcomings that need addressing, which could be resolved through further research. (Rowicki A,. et al., 2023)		prevent aircraft collisions.
	C. Operational Impacts	Q1. The addition of bird-repellent technology has led to fewer disruptions and smoother airport operations. Q2. The bird-repellent systems have manageable calibration requirements and a favorable operational impact. Q3. The improved bird deterrent system integrates well with current airport operations and protocols. Q4. The bird-repellent system has a positive impact on overall flight safety and efficiency. Q5. The sound and visual bird repellents significantly reduce bird-aircraft incidents, and many aviation professionals are generally satisfied with their performance.
Related Literature Study	**Statement of The Problem 4:**	**Statements in the survey questionnaire**
1. Based on the study's findings, a set of 9 flickering lights patterns showed a significant reduction and time for birds to flee. Honda, T., Tominaga, H., & Shimizu, A. (2024) 2.The study demonstrated that an audible sound field reduced birds' flight speed by 2.02 m/s, about 20% slower than normal, compared to a 1.07 m/s reduction without sound. This could significantly lower collision force. Further research on faster-flying birds in natural settings is needed. (Gehring et al., 2015). 3. The study explores the effectiveness of strategies to prevent bird strikes in aviation, including habitat management, scaring techniques, and radar systems. It underscores the importance of integrating multiple methods, acknowledging their individual strengths and limitations. The research calls for ongoing, data-driven assessments to enhance bird strike prevention and ensure operational efficiency and flight safety. (Metz et al. 2021)	How Effective is the In-flight Bird Repellent Equipment system during the various phase	Q1. Light related bird repellent showed significant effect in reducing the number of birds and the time for birds to flee the area. Q2. The in-flight-bird repellent equipment effectively reduces bird flight speed and collision force within the take off phase. Q3. The use of radar systems has been effective in detecting birds and reducing bird strikes. *Q4. During the cruise, the presence of the bird-repellent system contributes to a significant reduction in bird strikes. Q5. The ultrasonic frequencies are effective in repelling birds during the landing and takeoff phases of flight.

4. The effectiveness of in-flight bird-repellent systems during different flight phases was studied by Cleary et al. (2020). 5 The effective method is ultrasonic radiation to repel birds by emitting frequencies between 20 and 30 kHz, which disturbs them without causing harm. Since ultrasound travels faster than an airplane, it can be deployed effectively just after takeoff and before landing, provided that the device generates these frequencies with sufficient power for optimal results. (Rao, N. et al., 2020).		

Legend: * - The statement has been revised for the Final Survey

Appendix B: Validation And Pilot Test Results

Mr. Hans Guevera

PATTS College of Aeronautics

Assessment of Bird Repellent Equipment in Aviation: A Focus on In-Flight System

Thank you for participating in our survey! Your feedback is valuable in helping us improve our research.
Please put a check ✔ on each statement based on its usefulness to you:

4 - Very Useful 3 - Useful with Revision 2 - Change Statement 1 - Remove Statement

No	Questions	4	3	2	1
1	**What are the limitations of the current bird repellent and how do we improve the system for aviation safety**				
1.1	The limitations of current bird repellents are based on the environment and its operation.	✓			
1.2	The current bird-repellent systems can be improved by means of enhancing their effectiveness and addressing reliability issues.	✓			
1.3	Certain bird repellents face issues when it comes to environmental factors in contrast with: Natural light, Foggy and cloudy weather.		✓		
1.4	Aviation safety can be enhanced by improving the bird-repellent system, especially during flight.	✓			
1.5	With current bird repellent there are certain limitations with its effectiveness against certain bird species.	✓			
2	**Compared to the existing system, is there a statistically significant reduction in bird strikes after applying in-flight bird repellent?**				
2.1	Reductions of bird strike are effective based on how accurate the detection system of birds within the area.		✓		
2.2	Statistical analysis shows that in-flight bird-repellent systems reduce bird strikes by a significant margin compared to the existing bird-repellent system.		✓		
2.3	The statistical analysis showed bird repellent trials and testing provided mix results when conditioned to certain conditions and applications.	✓			
2.4	The reduced bird strike is heavily dependent on the number of flight operations happening in the area.		✓		
2.5	Bird repellent systems showed a significant amount of reduction when it came to the use of pulsing light systems.	✓			
3	**What are the aviation professionals' perceptions in terms of:**				

	A. Effectiveness B. Reliability C. Operational Impacts				
A.	**EFFECTIVENESS**				
3.1.1	Sound and visual deterrents used in bird-repellent systems are generally effective in deterring birds.	✓			
3.1.2	Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff.	✓			
3.1.3	The strong sound field is highly effective, according to aviation professionals, in lowering bird flying speed and increasing safety.		✓		
3.1.4	The operational safety of aviation with regard to bird strikes can be enhanced through effective in-flight bird-repellent.	✓			
3.1.5	The effectiveness of current bird repellent systems, such as sound and visual repellents, in preventing aircraft collisions is satisfactory.	✓			
B.	**RELIABILITY**				
3.2.1	The technology consistently performs well, providing accurate information about bird activity.	✓			
3.2.2	The maintenance of bird-repellent systems is dependable, with few technical malfunctions and minimal maintenance issues.	✓			
3.2.3	The rotating speaker feature of the improved system ensures uniform sound distribution, making it more reliable.	✓			
3.2.4	Maintenance requirements for the bird-repellent system are minimal and straightforward.	✓			
3.2.5	The current bird-repellent systems, including sound and visual repellents, are dependable and successfully prevent aircraft collisions.	✓			
C.	**OPERATIONAL IMPACTS**				
3.3.1	The addition of bird-repellent technology has led to fewer disruptions and smoother airport operations.	✓			
3.3.2	The bird-repellent systems have manageable calibration requirements and a favorable operational impact.	✓			
3.3.3	The improved bird deterrent system integrates well with current airport operations and protocols.	✓			
3.3.4	The bird-repellent system has a positive impact on overall flight safety and efficiency.	✓			
3.3.5	The sound and visual bird repellents significantly reduce bird-aircraft collisions, and many aviation professionals are generally satisfied with their performance.	✓			
4	**How Effective is the In-flight Bird Repellent Equipment system during the various phases?**				

4.1	Light related bird repellent showed significant effect in reducing the number of birds and the time for birds to flee the area.	✓			
4.2	The in-flight-bird repellent equipment effectively reduces bird flight speed and collision force within the take off phase.	✓			
4.3	The use of radar systems has been effective in detecting birds and reducing bird strikes.	✓			
4.4	During the cruise, the presence of the bird-repellent system contributes to a significant reduction in bird strikes.				
4.5	The ultrasonic frequencies are effective in repelling birds during the landing and takeoff phases of flight.	✓			

Mr. Joselito N. Biera

PATTS College of Aeronautics

Assessment of Bird Repellent Equipment in Aviation: A Focus on In-Flight System

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4 - Very Useful 3 - Useful with Revision 2 - Change Statement 1 - Remove Statement

No	Questions	4	3	2	1
1	**What are the limitations of the current bird repellent and how do we improve the system for aviation safety**				
1.1	The limitations of current bird repellents are based on the environment and its operation.	✓			
1.2	The current bird-repellent systems can be improved by means of enhancing their effectiveness and addressing reliability issues.	✓			
1.3	Certain bird repellents face issues when it comes to environmental factors in contrast with: Natural light, Foggy and cloudy weather.	✓			
1.4	Aviation safety can be enhanced by improving the bird-repellent system, especially during flight.	✓			
1.5	With current bird repellent there are certain limitations with its effectiveness against certain bird species.	✓			
2	**Compared to the existing system, is there a statistically significant reduction in bird strikes after applying in-flight bird repellent?**				
2.1	Reductions of bird strike are effective based on how accurate the detection system of birds within the area.	✓			
2.2	Statistical analysis shows that in-flight bird-repellent systems reduce bird strikes by a significant margin compared to the existing bird-repellent system.	✓			
2.3	The statistical analysis showed bird repellent trials and testing provided mix results when conditioned to certain conditions and applications.	✓			
2.4	The reduced bird strike is heavily dependent on the number of flight operations happening in the area.	✓			
2.5	Bird repellent systems showed a significant amount of reduction when it came to the use of pulsing light systems.	✓			
3	**What are the aviation professionals' perceptions in terms of:**				

	A. Effectiveness B. Reliability C. Operational Impacts				
A.	**EFFECTIVENESS**				
3.1.1	Sound and visual deterrents used in bird-repellent systems are generally effective in deterring birds.	✓			
3.1.2	Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff.	✓			
3.1.3	The strong sound field is highly effective, according to aviation professionals, in lowering bird flying speed and increasing safety.	✓			
3.1.4	The operational safety of aviation with regard to bird strikes can be enhanced through effective in-flight bird-repellent.	✓			
3.1.5	The effectiveness of current bird repellent systems, such as sound and visual repellents, in preventing aircraft collisions is satisfactory.	✓			
B.	**RELIABILITY**				
3.2.1	The technology consistently performs well, providing accurate information about bird activity.	✓			
3.2.2	The maintenance of bird-repellent systems is dependable, with few technical malfunctions and minimal maintenance issues.	✓			
3.2.3	The rotating speaker feature of the improved system ensures uniform sound distribution, making it more reliable.	✓			
3.2.4	Maintenance requirements for the bird-repellent system are minimal and straightforward.	✓			
3.2.5	The current bird-repellent systems, including sound and visual repellents, are dependable and successfully prevent aircraft collisions.	✓			
C.	**OPERATIONAL IMPACTS**				
3.3.1	The addition of bird-repellent technology has led to fewer disruptions and smoother airport operations.	✓			
3.3.2	The bird-repellent systems have manageable calibration requirements and a favorable operational impact.	✓			
3.3.3	The improved bird deterrent system integrates well with current airport operations and protocols.	✓			
3.3.4	The bird-repellent system has a positive impact on overall flight safety and efficiency.	✓			
3.3.5	The sound and visual bird repellents significantly reduce bird-aircraft collisions, and many aviation professionals are generally satisfied with their performance.	✓			
4	**How Effective is the In-flight Bird Repellent Equipment system during the various phases?**				

4.1	Light related bird repellent showed significant effect in reducing the number of birds and the time for birds to flee the area.	✓			
4.2	The in-flight-bird repellent equipment effectively reduces bird flight speed and collision force within the take off phase.		✓		
4.3	The use of radar systems has been effective in detecting birds and reducing bird strikes.				
4.4	During the cruise, the presence of the bird-repellent system contributes to a significant reduction in bird strikes.		✓		
4.5	The ultrasonic frequencies are effective in repelling birds during the landing and takeoff phases of flight.	✓			

Capt. Kenn Jhorge A. Ponferrada

PATTS College of Aeronautics

Assessment of Bird Repellent Equipment in Aviation: A Focus on In-Flight System

Thank you for participating in our survey! Your feedback is valuable in helping us improve our research.
Please put a check ✔ on each statement based on its usefulness to you:

4 - Very Useful 3 - Useful with Revision 2 - Change Statement 1 - Remove Statement

No	Questions	4	3	2	1
1	**What are the limitations of the current bird repellent and how do we improve the system for aviation safety**				
1.1	The limitations of current bird repellents are based on the environment and its operation.				
1.2	The current bird-repellent systems can be improved by means of enhancing their effectiveness and addressing reliability issues.		✓		
1.3	Certain bird repellents face issues when it comes to environmental factors in contrast with: Natural light, Foggy and cloudy weather.	✓			
1.4	Aviation safety can be enhanced by improving the bird-repellent system, especially during flight.			✓	
1.5	With current bird repellent there are certain limitations with its effectiveness against certain bird species.		✓		
2	**Compared to the existing system, is there a statistically significant reduction in bird strikes after applying in-flight bird repellent?**				
2.1	Reductions of bird strike are effective based on how accurate the detection system of birds within the area.	✓			
2.2	Statistical analysis shows that in-flight bird-repellent systems reduce bird strikes by a significant margin compared to the existing bird-repellent system.		✓		
2.3	The statistical analysis showed bird repellent trials and testing provided mix results when conditioned to certain conditions and applications.			✓	
2.4	The reduced bird strike is heavily dependent on the number of flight operations happening in the area.	✓			
2.5	Bird repellent systems showed a significant amount of reduction when it came to the use of pulsing light systems.	✓			
3	**What are the aviation professionals' perceptions in terms of:**				

	A. Effectiveness B. Reliability C. Operational Impacts				
A.	**EFFECTIVENESS**				
3.1.1	Sound and visual deterrents used in bird-repellent systems are generally effective in deterring birds.				
3.1.2	Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff.	✓			
3.1.3	The strong sound field is highly effective, according to aviation professionals, in lowering bird flying speed and increasing safety.	✓			
3.1.4	The operational safety of aviation with regard to bird strikes can be enhanced through effective in-flight bird-repellent.	✓			
3.1.5	The effectiveness of current bird repellent systems, such as sound and visual repellents, in preventing aircraft collisions is satisfactory.				
B.	**RELIABILITY**				
3.2.1	The technology consistently performs well, providing accurate information about bird activity.	✓			
3.2.2	The maintenance of bird-repellent systems is dependable, with few technical malfunctions and minimal maintenance issues.	✓			
3.2.3	The rotating speaker feature of the improved system ensures uniform sound distribution, making it more reliable.	✓			
3.2.4	Maintenance requirements for the bird-repellent system are minimal and straightforward.	✓			
3.2.5	The current bird-repellent systems, including sound and visual repellents, are dependable and successfully prevent aircraft collisions. incidents	✓			
C.	**OPERATIONAL IMPACTS**				
3.3.1	The addition of bird-repellent technology has led to fewer disruptions and smoother airport operations.	✓			
3.3.2	The bird-repellent systems have manageable calibration requirements and a favorable operational impact.			✓	
3.3.3	The improved bird deterrent system integrates well with current airport operations and protocols.	✓			
3.3.4	The bird-repellent system has a positive impact on overall flight safety and efficiency.	✓			
3.3.5	The sound and visual bird repellents significantly reduce bird-aircraft collisions, and many aviation professionals are generally satisfied with their performance.				
4	**How Effective is the In-flight Bird Repellent Equipment system during the various phases?** of what ?				

4.1	Light related bird repellent showed significant effect in reducing the number of birds and the time for birds to flee the area.		✓		
4.2	The in-flight-bird repellent equipment effectively reduces bird flight speed and collision force within the take off phase.	✓			
4.3	The use of radar systems has been effective in detecting birds and reducing bird strikes.	✓			
4.4	During the cruise, the presence of the bird-repellent system contributes to a significant reduction in bird strikes.				✓
4.5	The ultrasonic frequencies are effective in repelling birds during the landing and takeoff phases of flight.		✓		

Pilot Test Results

PATTS College of Aeronautics

Assessment of Bird Repellent Equipment in Aviation: A Focus on In-Flight System

Thank you for participating in our survey! Your feedback is valuable in helping us improve our research. Please put a check ✔ on each statement based on its usefulness to you:

4 - Very Useful 3 - Useful with Revision 2 - Change Statement 1 - Remove Statement

No	Questions	4	3	2	1
1	**What are the limitations of the current bird repellent and how do we improve the system for aviation safety**				
1.1	The limitations of current bird repellents are based on the environment and its operation.	2		1	
1.2	The current bird-repellent systems can be improved by enhancing their effectiveness and addressing reliability issues.	2	1		
1.3	Certain bird repellents face issues when it comes to environmental factors, such as natural light and foggy and cloudy weather.	2	1		
1.4	Aviation safety can be enhanced by improving the bird-repellent system, especially during flight.	2		1	
1.5	With current bird repellent there are certain limitations to its effectiveness against certain bird species.	2	1		
2	**Is there a statistically significant reduction in bird strikes after applying in-flight bird repellent compared to the existing system?**				
2.1	Reductions of bird strikes are effective based on how accurate the detection system of birds is during the migration season within the area.	2	1		
2.2	Statistical analysis shows that in-flight bird-repellent systems reduce bird strikes by a significant margin compared to the existing bird-repellent system.	1	2		
2.3	The statistical analysis showed bird repellent trials and testing provided mixed results when conditioned to certain conditions and applications.	2		1	
2.4	The reduced bird strike is heavily dependent on the number of flight operations happening in the area.	2	1		
2.5	Bird-repellent systems showed a significant amount of reduction when it came to the use of pulsing light systems.	3			
3	**What are the aviation professionals' perceptions in terms of:**				

	A. Effectiveness B. Reliability C. Operational Impacts				
A.	**EFFECTIVENESS**				
3.1.1	Sound and visual deterrents used in bird-repellent systems are generally effective in deterring birds.	2		1	
3.1.2	Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff.	3			
3.1.3	The strong sound field is highly effective, according to aviation professionals, in lowering bird flying speed and increasing safety.	2	1		
3.1.4	The operational safety of aviation about bird strikes can be enhanced through effective in-flight bird-repellent.	3			
3.1.5	The effectiveness of current bird-repellent systems, such as sound and visual repellents, in preventing aircraft collisions is satisfactory.	2		1	
B.	**RELIABILITY**				
3.2.1	The technology consistently performs well, providing accurate information about bird activity.	3			
3.2.2	The maintenance of bird-repellent systems is dependable, with few technical malfunctions and minimal maintenance issues.	3			
3.2.3	The rotating speaker feature of the improved system ensures uniform sound distribution, making it more reliable.	3			
3.2.4	Maintenance requirements for the bird-repellent system are minimal and straightforward.	3			
3.2.5	The current bird-repellent systems, including sound and visual repellents, are dependable and successfully prevent aircraft collisions.	3			
C.	**OPERATIONAL IMPACTS**				
3.3.1	The addition of bird-repellent technology has led to fewer disruptions and smoother airport operations.	3			
3.3.2	The bird-repellent systems have manageable calibration requirements and a favorable operational impact.	2		1	
3.3.3	The improved bird deterrent system integrates well with current airport operations and protocols.	3			
3.3.4	The bird-repellent system has a positive impact on overall flight safety and efficiency.	3			
3.3.5	The sound and visual bird repellents significantly reduce bird-aircraft collisions, and many aviation professionals are generally satisfied with their performance.	2		1	
4	**How Effective is the In-flight Bird Repellent Equipment system during the various phases?**				

4.1	Light-related bird repellent showed a significant effect in reducing the number of birds and the time for birds to flee the area.	2	1		
4.2	The in-flight-bird repellent equipment effectively reduces bird flight speed and collision forces within the take-off phase.	2	1		
4.3	The use of radar systems has been effective in detecting birds and reducing bird strikes.	2			1
4.4	During the cruise, the presence of the bird-repellent system contributes to a significant reduction in bird strikes.		1		2
4.5	The ultrasonic frequencies are effective in repelling birds during the landing and takeoff phases of flight.	2	1		

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Appendix C: Final Instruments

Official Survey for Research Entitled: Assessment of Bird Repellent Equipment in Aviation: A focus on In-flight system

This is the **MAIN SURVEY**. Your feedback is crucial in helping us refine and improve the research instruments before full-scale implementation. The purpose of this survey is to identify any potential issues, unclear questions, or areas where we can make our future decisions .

Your responses will be used solely for the purpose of gathering insights and feedbacks in our survey and ensuring that it accurately captures the data required for the research. All information provided will be treated with the utmost confidentiality, and no personal identifying information will be shared without your consent. Take note that this is only voluntary and you may withdraw without consequences.

Please take your time to complete the survey honestly, and feel free to provide any additional comments or suggestions at the end. Your input is invaluable in helping us create a better and more effective research tool.

ONLINE DATA PRIVACY AND CONFIDENTIALITY

The information contained, collected, used, shared, disclosed, and stored in this form are held confidential and intended only for the purpose of this activity, in compliance with the standard prescribed by the DATA PRIVACY ACT 2012.

Do you give your consent for the processing, releasing, and/or retention of your personal information? *

- ○ Yes, I fully give my consent for the processing, releasing, and/or retention of my personal information.
- ○ No, I do not give my consent for the processing, releasing, and/or retention of my personal information.

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PROFILE

Full Name (Surname, First Name, Middle Initial) *

Your answer

Sex *

- ◯ Male
- ◯ Female

Age *

- ◯ Up to 30 years old
- ◯ 31 - 40 years old
- ◯ 41 - 50 years old
- ◯ Over 50 years old

Specialization *

- ◯ Aeronautical Engineer
- ◯ Commercial Pilot (Single, Multi, Helicopter)
- ◯ Private pilot (Single, Multi Engine)
- ◯ Aircraft Maintenance Technician
- ◯ Flight Dispatcher
- ◯ Aviation Maintenance Specialist (Avionics Rating)
- ◯ Aircraft Maintenance Technician (Aircraft Rating)

Working experience *

- ◯ Less than 1 year
- ◯ 1-5 Years
- ◯ 6-10 Years
- ◯ More than 10 Years

Back Next Clear form

Survey Question #1

What are the limitations of the current bird repellent and how do we improve the system for aviation safety? *

	4 - Strongly Agree	3 - Agree	2 - Disagree	1 - Strongly Disagree
The limitations of current bird repellents are based on the environment and its operation.	○	○	○	○
The current bird-repellent system can be improved by enhancing their effectiveness and addressing reliability issues.	○	○	○	○
Current bird repellents can adapt to various environmental conditions, such as natural light or foggy and cloudy weather, enhancing their effectiveness.	○	○	○	○
Aviation safety can be enhanced by improving the bird-repellent system, especially during Landing and Take-off.	○	○	○	○
With Current bird repellents, there are opportunities to further enhance the effectiveness against certain bird species.	○	○	○	○

Survey Question #2

Is there a statistically significant reduction in bird strikes after applying in-flight bird repellent compared to the existing system? *

	4 - Strongly Agree	3 - Agree	2 - Disagree	1 - Strongly Disagree
Reductions of bird strikes are effective based on how accurate the detection system of birds is during the migration season within the area.	○	○	○	○
Statistical analysis shows that using ultrasonic waves and flashing lights is more effective by a significant margin compared to existing bird-repellent systems.	○	○	○	○
The statistical analysis revealed that bird repellent trials and testing successfully identified bird population trends in the area under various environmental conditions and applications.	○	○	○	○
The reduced bird strike is heavily dependent on the number of flight operations happening in the area.	○	○	○	○
Bird-repellent systems showed a significant amount of reduction when it came to the use of pulsing light systems.	○	○	○	○

Survey Question #3

What are the aviation professionals' perceptions in terms of:
A. Effectiveness B. Reliability C. Operational Impacts

A.) Effectiveness *

	4 - Strongly Agree	3 - Agree	2 - Disagree	1 - Strongly Disagree
Sound and visual deterrents used in bird-repellent systems are generally effective in deterring birds.	○	○	○	○
Aviation professionals find that bird-repellent systems are highly effective in reducing bird strikes during takeoff.	○	○	○	○
The Ultrasonic frequency is highly effective, according to aviation professionals, in lowering bird flying speed and increasing safety.	○	○	○	○
The operational safety of aviation about bird strikes can be enhanced through effective in-flight bird-repellent.	○	○	○	○
The effectiveness of current bird-repellent systems, such as sound and visual repellents, in preventing aircraft incidents is satisfactory.	○	○	○	○

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B.) Reliability *

	4 - Strongly Agree	3 - Agree	2 - Disagree	1 - Strongly Disagree
The technology consistently performs well, providing accurate information about bird activity.	○	○	○	○
The maintenance of bird-repellent systems is dependable, with few technical malfunctions and minimal maintenance issues.	○	○	○	○
The rotating speaker feature of the improved system ensures uniform sound distribution, making it more reliable.	○	○	○	○
Maintenance requirements for the bird-repellent system are minimal and straightforward.	○	○	○	○
The current bird-repellent systems, including sound and visual repellents, are dependable and successfully prevent aircraft incidents.	○	○	○	○

C.) Operational Impacts *

	4 - Strongly Agree	3 - Agree	2 - Disagree	1 - Strongly Disagree
The addition of bird-repellent technology has led to fewer disruptions and smoother airport operations.	○	○	○	○
The bird-repellent systems have manageable calibration requirements and a favorable operational impact.	○	○	○	○
The improved bird deterrent system integrates well with current airport operations and protocols.	○	○	○	○
The bird-repellent system has a positive impact on overall flight safety and efficiency.	○	○	○	○
The sound and visual bird repellents significantly reduce bird-aircraft incidents, and many aviation professionals are generally satisfied with their performance.	○	○	○	○

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Survey Question #4 *

How Effective is the In-flight Bird Repellent Equipment system during landing and Take-off?

	4 - Strongly Agree	3 - Agree	2 - Disagree	1 - Strongly Disagree
Light-related bird repellent showed a significant effect in reducing the number of birds and the time for birds to flee the area.	○	○	○	○
The in-flight-bird repellent equipment effectively reduces bird flight speed and incident force within the take-off phase.	○	○	○	○
The use of radar systems has been effective in detecting birds and reducing bird strikes.	○	○	○	○
The ultrasonic frequencies are effective in repelling birds during the landing and takeoff phases of flight.	○	○	○	○

Appendix D: Letters

PATTS College of Aeronautics

PATTS COLLEGE OF AERONAUTICS
Lombos Avenue, San Isidro, Paranaque City 1700
TEL: 8825-8823 | 8825-8824

25 September 2024

Mr. Hans Guevara
Flight Dispatcher
Cebu Pacific, Inc.

Invitation to Validate Thesis Question

Dear Mr. Guevara,

Greetings from the Student Researchers of the Bachelor of Science in Air Transportation!

We hope this letter finds you well. We, the researchers of **"Assessment of Bird Repellent Equipment in Aviation: A Focus on In-flight System"** of ATRN 417, Section 3A, would like to request for your guidance in validating an important research tool we have created for our thesis.

Your expertise in this area would be extremely valuable, and we would greatly appreciate your feedback and suggestions. Your insights will be significant to ensuring the credibility and success of our thesis.

Thank you for considering our request. We look forward to your positive response, as your guidance will be important for the success of our research.

Respectfully yours,

Ashly Jamiah Manato
Group Representative

Noted by:

Dr. Marianne Shalimar Del Rosario
Professor, ATRN 417

Approved by:

Mr. Hans Guevara
Validator

PATTS
College of Aeronautics

PATTS COLLEGE OF AERONAUTICS
Lombos Avenue, San Isidro, Paranaque City 1700
TEL: 8825-8823 | 8825-8824

25 September 2024

Mr. Joselito N. Biera
Chairperson, BS Aircraft Maintenance Technology Program & Aircraft Technician Course
PATTS College of Aeronautics

Invitation to Validate Thesis Question

Dear Mr. Biera,

Greetings from the Student Researchers of the Bachelor of Science in Air Transportation!

We hope this letter finds you well. We, the researchers of **"Assessment of Bird Repellent Equipment in Aviation: A Focus on In-flight System"** of ATRN 417, Section 3A, would like to request for your guidance in validating an important research tool we have created for our thesis.

Your expertise in this area would be extremely valuable, and we would greatly appreciate your feedback and suggestions. Your insights will be significant to ensuring the credibility and success of our thesis.

Thank you for considering our request. We look forward to your positive response, as your guidance will be important for the success of our research.

Respectfully yours,

Ashly Jamiah Manato
Group Representative

Noted by:

Dr. Marianne Shalimar Del Rosario
Professor, ATRN 417

Approved by:

Mr. Joselito N. Biera
Validator

PATTS
College of Aeronautics

PATTS COLLEGE OF AERONAUTICS
Lombos Avenue, San Isidro, Paranaque City 1700
TEL: 8825-8823 | 8825-8824

25 September 2024

Capt. Kenn Jhorge A. Ponferrada
BSAT - Instructor
PATTS College of Aeronautics

Invitation to Validate Thesis Question

Dear Capt. Ponferrada,

Greetings from the Student Researchers of the Bachelor of Science in Air Transportation!

We hope this letter finds you well. We, the researchers of **"Assessment of Bird Repellent Equipment in Aviation: A Focus on In-flight System"** of ATRN 417, Section 3A, would like to request for your guidance in validating an important research tool we have created for our thesis.

Your expertise in this area would be extremely valuable, and we would greatly appreciate your feedback and suggestions. Your insights will be significant to ensuring the credibility and success of our thesis.

Thank you for considering our request and we look forward to your positive response.

Respectfully yours,

Ashly Jamiah D. Manato
Representative, Group 1

Noted by:

Dr. Marianne Shahmar Del Rosario
Professor, ATRN 417

Approved by:

Capt. Kenn Jhorge A. Ponferrada.
Validator

RD FORM NO.9

PATTS COLLEGE OF AERONAUTICS

Research and Development Center

REQUEST FOR LANGUAGE

February 02, 2025

Date

TO	**:**	
		Language Editor
SUBJECT	**:**	**Request for Language Editing**
THESIS/DISSERTATION TITLE	**:**	EVALUATING THE APPLICATION OF BIRD REPELLENT TECHNOLOGY IN IN-FLIGHT SYSTEMS: INSIGHTS FROM AVIATION PROFESSIONALS
NUMBER OF PAGE	**:**	**69 pages**
RESEARCHER/S	**:**	Aldrin Adrian Arong, Edwin Cubian Jr., Rey Justin Daayata, Lianne Krisha Dela Cruz, Matthew Nicholas Espares, Ashly Jamiah Manato, Ruzle Suldan
DATE DUE	**:**	
REQUESTED BY	**:**	**Manato, Ashly Jamiah D.**

I certify that I have edited the research mentioned above and that all my corrections have been incorporated into all copies of the manuscript.

Signature over Printed Name of Edit

Date

Copies to: Adviser, Research and Student

RD Form 9-2024

Appendix E: SPSS Tables/Meta-Analysis Tables

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SOP1Q1	33	2.00	4.00	3.2121	.48461
SOP1Q2	33	3.00	4.00	3.6061	.49620
SOP1Q3	33	2.00	4.00	3.1515	.66714
SOP1Q4	33	3.00	4.00	3.6970	.46669
SOP1Q5	33	2.00	4.00	3.3636	.60302
Valid N (listwise)	33				

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SOP2Q1	33	2.00	4.00	3.3333	.59512
SOP2Q2	33	2.00	4.00	3.2727	.57406
SOP2Q3	33	2.00	4.00	3.1818	.58387
SOP2Q4	33	2.00	4.00	3.1212	.78093
SOP2Q5	33	2.00	4.00	3.1212	.64988
Valid N (listwise)	33				

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SOP3AQ1	33	3.00	4.00	3.4242	.50189
SOP3AQ2	33	3.00	4.00	3.3939	.49620
SOP3AQ3	33	2.00	4.00	3.2121	.54530
SOP3AQ4	33	1.00	4.00	3.2727	.62614
SOP3AQ5	33	2.00	4.00	3.2727	.57406
Valid N (listwise)	33				

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SOP3BQ1	33	2.00	4.00	3.1818	.46466
SOP3BQ2	33	2.00	4.00	3.1818	.58387
SOP3BQ3	33	2.00	4.00	3.0909	.63066
SOP3BQ4	33	2.00	4.00	3.0909	.52223
SOP3BQ5	33	2.00	4.00	3.2121	.59987
Valid N (listwise)	33				

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SOP3CQ1	33	2.00	4.00	3.3636	.65279
SOP3CQ2	33	2.00	4.00	3.2727	.62614
SOP3CQ3	33	2.00	4.00	3.2121	.54530
SOP3CQ4	33	2.00	4.00	3.3939	.55562
SOP3CQ5	33	2.00	4.00	3.3030	.63663
Valid N (listwise)	33				

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SOP4Q1	33	1.00	4.00	3.1212	.59987
SOP4Q2	33	1.00	4.00	3.1515	.66714
SOP4Q3	33	2.00	4.00	3.3030	.52944
SOP4Q4	33	3.00	4.00	3.2727	.45227
Valid N (listwise)	33				

Appendix F: Interview Transcript

Informant 1

Researcher: For our first question, what insights have you had from airports or the aviation industry regarding how well this adaptable in-flight bird-repellent works in actual situations?

Informant 1: Okay, as of now, we have the existing uhm, bird-repellent installed in the different uh airports noh, just to stay away from this uh type of incident. But as of now, uh we don't have uh any birds-repellent uh installed on the aircraft.

Researcher: Uh alright. The next one is the what challenges do you anticipate in preventing the hazards of bird strikes as aviation traffic grows? And what do you think will be the adjustments airports can make to overcome these challenges?

Informant 1: Well uh, as of now, uh according to the study of the FAA, the Federal Aviation Administration, the aviation industry although it take precaution, uh in order to uh have this incident could be uh prevented noh. Uh so part of the study is the uhm this season noh, this season wherein migratory birds uh came from one location to another. Uh just to warn the uh aviation industry particularly airlines which regards to this type of hazard.

Researcher: Noted. Uhm for the next part is, when it comes to bird-repellent effectiveness, reliability, and operational safety of aviation, what are your views regarding its compatibility in in-flight operations?

Informant 1: Well uh in the in-flight uh operations, as of now in your thesis proposed, uh we don't have any uh bird-repellent installed in the aircraft but there might be some study that it is doable. Now, the challenge uh for the in-flight repellent installed in the aircraft because this repellent it depends upon the component on mechanism. Uh please take note that anything we install in the aircraft it adds weight to the aircraft. So there might be some challenges that when we install this uh portable or repellent on the aircraft it might, one consideration is the weight of this mechanism or the vast.

Researcher: Thank you sir!. Now for the next one, how effective do you think a bird repellent would be when it comes to preventing bird strikes?

Informant 1: Well, according to the study, it's very effective. You know, every year there's always a bird strike happening all around the world. In our country, the Philippines, I think we also have this type of repellent installed in the airport. But unlike other countries, the Philippines is not really hit by the bird strike within the airport area or the vicinity.

Researcher: And for our last one is, what do you think can be an improvement for the overall effectiveness of the bird repellent system during takeoff and landing?

Informant 1: Well for the take off and landing, well, that's that's good on your proposal with regards to the in flight birds repeated because if it is installed in the aircraft, then it might be as well effective during the landing or even during the takeoff, just the stay out of the bird strike. But as of now, as I mentioned that what we have right now for the bird repellent is the existing in the aviation industry and I think that's the only way we could stay away from Bird Strike.

Researcher: Thank you for your insight for our interview. Now, is there anything else you would like to add for?

Informant 1: So far again, I really appreciate the study. When it comes to the portable bird repellent installed in the aircraft, you could explore many things and in your research, you might as well include the expert in the industry, particularly with the airline company as well as the aircraft manufacturer if it's okay. Because they have, they will provide you some insights regarding that and study the different RRLs because it might provide us more confidence that your prototyping or proposed research might be as well as effective compared with the other or in our existing bird repellent.

Researcher: Thank you so much sir!

Informant 2

Researcher: Good Afternoon Sir, we would like to Initiate an Interview and get a better insight and experience, when it comes to the avionics part sir. When it comes to our proposed research in bird repellent, the first question is. What Insights have you had from airports or the aviation industry regarding how well this adaptable in-flight bird-repellent works in actual situations?

Informant 2: When it comes to the actual situation of bird repellent. It is not 100 percent reliable because, of course we are talking about

Researcher: Yes, Sir.

Informant 2: Frequency. Uh, How many birds are uh, what species of bird that the repellant can avoid to the airport and how accurate that the numbers of bird can it repel

Researcher: Yes, sir.

Informant 2: So for me the in-flight bird repellent is not that reliable.

Researcher: Thank you for that answer. Sir, for the next question, sir. Uh, what challenge do you anticipate in preventing the hazards of bird strike as aviation traffic grows? So what do you think will be the adjustments that airports can make on this challenge?

Informant 2: As I mentioned earlier. So the numbers of birds that are not prone to bird repellent because not all types of birds can be affected by the frequency of the bird repellent. However, it would have a reduction of the bird strike that would happen in the airport. And that's the purpose of the bird repellent.

Researcher: Yes, sir. So, next, sir, sir. Sir, when it comes to bird repellent effectiveness, reliability and operational safety in aviation. What are your views, regarding its compatibility in flight operation?

Informant 2: So, when it comes to compatibility or regarding those you mentioned earlier. When it comes to the bird repellent, operations. Am I right, airport?

Researcher: Yes, sir.

Informant 2: Airport. I think it will be effective, as of now, but as I mentioned earlier. How many birds are affected by that specific bird repellent? If the bird is only affected by a small amount. Meaning there is a species of bird that is not affected by the repellent. Possibly. Some birds cannot be repelled by the repellent, and it would go to the airport and cause some accident or bird strike and then to improve the reliability of the bird repellent. Maybe the solution is to make a stronger frequency so that all birds can be repelled by the repellent or maybe create another type of bird repellent aside from frequency.

Researcher: So, next question, sir, how effective is In-flight bird-repellent system? When it comes to birds strike. Because sir, there's a difference between airport bird repellent and in-flight bird repellent.

Informant 2: So, when it comes to bird strike in the aircraft. So I think, is it still frequency?

Researcher: Yes, sir.

Informant 2: I think, uhh there is another type of bird repellent we use aside from frequency in the aircraft. So, I think the engine helps repelling birds. In the center of the engine there is a paint in white and black and that helps to repel birds aside from frequency type bird repellent. I think this is good.

Researcher: Yes, sir. Thank you, sir. For the last question. What do you think bird repellents need to improve when it comes to overall effectiveness of a bird repellent system during takeoff and landing?

Informant 2: So I think. Before takeoff we need the assurance that there are no birds in the vicinity of the airport. Second, landing we need to assure again as the same in the takeoff part that in the runway. I think that the personnel need to help beside the system we use, that there are no birds or any species of birds in the vicinity of the airport. This helps the system to repel birds.

Researcher: So, that concludes for this thesis sir. Thank you so much, sir.

Informant 2: Oh, thank you, thank you.

Informant 3

Researcher: Good afternoon sir (Confidential), Thank you for participating in this interview. The main purpose of the discussion is to gain ideas and expert comments on the efficacy and operational aspects of bird-repellant systems in aviation, with a special emphasis on in-flight applications. Uhmmm Your participation will be critical in providing useful data for the thesis on evaluating the effect of bird-repellent technology in improving flight safety and minimizing bird-related collisions.

Informant 3: Yes, It's okay, I will participate, can I get the questions so I can prepare my statements.

Researcher: Yes sir sure here it is, sir (confidential) please be aware sir that all information you would give during this interview will be kept totally concealed and used solely for academic purposes relating to this thesis. Personal identifiers or sensitive data will not be given to anybody other than the research team in accordance with research ethical considerations. Your participation is fully optional, and you may withdraw at any moment with no penalties. Can we have the permission to record now sir?

Informant 3: Okay sure it's just a voice record right?

Researcher: Yes sir just a voice recording only.

Researcher: Okay sir, for our first question sir uhmm tsk, what insights have you had from airports or the aviation industry regarding how well this adaptable in-flight bird-repellent works uhmm in actual situations?

Informant 3: Yes I have an idea with the bird repellent however, not as thorough as experts on how bird repellent systems function in technicalities.

Researcher: So, what are those ideas sir regarding that?

Informant 3: Uhmm maybe the most simplest type of repellent, just like in repelling dogs, or just like in heathrow airport, they used machines cause sometimes there are flock of birds that migrates in the area, and type of that machine is chasing the birds away, however uhmm I did not know what specifically type of machine is that.

Researcher: Okay thank you sir!, So, for the next question sir, is what challenges do you anticipate in preventing the hazards of bird strikes as aviation traffic grows? And additional sir, uhmm what do you think will be the adjustments airports can make to overcome these challenges?

Informant 3:hmmm Adjustment of airports in terms of bird repelling?? Ahh okay, maybe I will just base it on my experience when I was doing my flight lessons, maybe let's start small, it's better to start in General aviation, and before I took off there was a bird that hit my windshield specifically in the part of the propeller, you know, in Cessna the propeller is placed in front.

Researcher: Yes sir, in front

Informant 3: Then, if that happens you will not have visuals anymore, so I think it much better if let's start here for example in the Philippines in all airports, they should implement a machine that would repel birds, especially to the starting pilots in Gen Av. It would have uhm reduction when it comes uh uh,to the strike.

Researcher: Ohh in Gen Av first sir, okay thank you for that answer sir. Now let's move on to the third question sir. So when it comes to the bird repellent's Effectiveness, Reliability and also its Reliability, when it comes to aviation. What are your views when it comes to its compatibility?

Informant 3: Compatibility in operation? In what sense?

Research: The bird repellent when it comes to its effectiveness, reliability and if it's going to be successful

Informant 3: Very much yes, Especially in the commercial industry or commercial aviation industry. Because once it is implemented uhhhh imagine if it's 100% Successful. There would be no delays, smooth operations, and both the time of passengers and crew won't be busy.

Research: Yes Sir, So for the fourth question sir, How effective do you think the bird repellent when it comes to preventing bird strikes?

Informant 3: Maybe with the current, if i'm going to base it from the heathrow, the one i mentioned a while ago, it is 100% effective, knowing that heathrow airport is a big area, cause if we know if their is big space in one area, also if it is a big space for the birds fly around in, Especially during migrating season. So if the bird repellent is effective in Heathrow Airport, if they implement it in other airports, It would be good.

Researcher: Yes sir, Thank you Sir. So for the last question sir. What do you think can be an improvement for the overall effectiveness of the bird-repellent systems during take-off and landing?

Informant 3: MmmmmMmmmm… Maybe in it's improvement, Let's say…

Researcher: Overall Improvements

Informant 3: Overall Improvements, Maybe if it's already implemented, and its doing a good job already, I'd say minor revision instead

Researcher: Minor Revisions?

Informant: Yes, Minor Revisions. That's it. Especially with the weather. For example, We can't really say that the weather could affect the operations of the actual system. Yeah that's it.

Researcher 2: Uh just for anything um… Is there anything you would like to add to our research if you have any insights to our research?

Informant: Mmmmmm… How many have you guys interviewed so far?

Research 1 and 2: Uhhh so far you are our last one sir.

Informant: Ahhh okay so maybe you can ask the other instructors who aren't in the air trans department, or wait does it have to be within redacted only?

Researcher 1: No sir.

Informant: Maybe if you want you can research other people outside, Example you guys to the airport, you can ask professionals if it isn't hassle. But yeah that's it.

Researcher 1: Okay that will be all sir, Thank you for participating in our interview

Informant: Yes thank you guys, and good luck on your thesis.

Appendix G: Plagiarism Check

DrillBit

The Report is Generated by DrillBit AI Content Detection Software

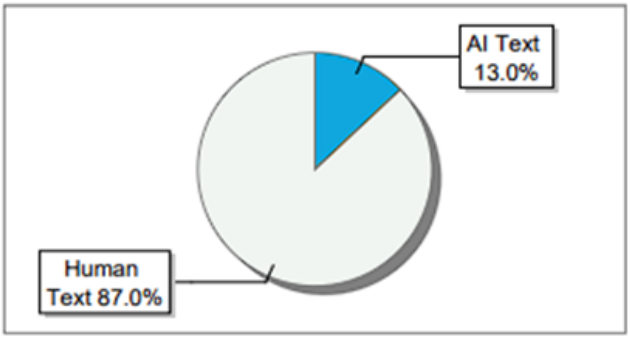
Submission Information

Author Name	Manato
Title	ATRN 417
Paper/Submission ID	2604141
Submitted By	ashlyjamiah.manato@patts.edu.ph
Submission Date	2024-11-27 17:22:19
Total Pages	65
Document type	Assignment

Result Information

AI Text: **13 %**

Content Matched



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* The content detection system employed here is powered by artificial intelligence (AI) technology.
* Its not always accurate and only help to author identify text that might be prepared by a AI tool.
* It is designed to assist in identifying & moderating content that may violate community guidelines/legal regulations, it may not be perfect.

DrillBit

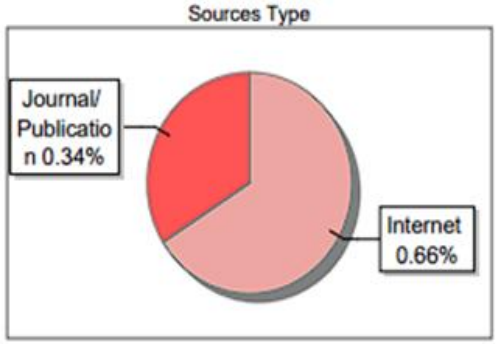
The Report is Generated by DrillBit Plagiarism Detection Software

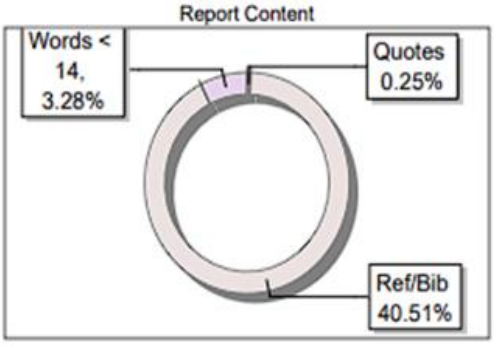
Submission Information

Author Name	Manato
Title	ATRN 417
Paper/Submission ID	2604141
Submitted by	ashlyjamiah.manato@patts.edu.ph
Submission Date	2024-11-27 17:22:19
Total Pages, Total Words	65, 13725
Document type	Assignment

Result Information

Similarity **1 %**





Exclude Information

Quotes	Excluded
References/Bibliography	Excluded
Source: Excluded < 14 Words	Excluded
Excluded Source	**0 %**
Excluded Phrases	Excluded

Database Selection

Language	English
Student Papers	Yes
Journals & publishers	Yes
Internet or Web	Yes
Institution Repository	Yes

A Unique QR Code use to View/Download/Share Pdf File

Appendix H: Bionote

ASHLY JAMIAH D. MANATO Also known as Ash is 21 years old, a Fourth-year student with a degree of Bachelor of Science in Air Transportation at PATTS College of Aeronautics, he is known as a dedicated student leader throughout his years of experience in academic years 2023-2024 as the Corps Commander, and handling responsibility and accountability overall in an office Military Organization (134th Department of Military Science and Tactics, PATTS College of Aeronautics), he participated in leadership collaboration events of different organizations at PATTS College of Aeronautics wherein he gained and adapted knowledge and skills. In the Academic Year 2022-2023, He was awarded the Leadership Award for outstanding leadership and exceptional skills within the organization and the community. He also then served as Provost Marshal during that time wherein he instilled Disciplinary actions, Peace, and Security within his military organization and the PATTS Community. He always knew the values of being a man in uniform through Discipline, Character Development, and Professionalism at all times.

ALDRIN ADRIAN C. ARONG, born on December 1, 1998, is also a fourth-year college student at PATTS College of Aeronautics and an incoming graduate taking up the course Bachelor of Science in Air Transportation. He is a dedicated leader, currently serving as the team leader of the Parish Youth at Cathedral Imus. With a passion for community service and advocacy, He has successfully organized several initiatives, including the monthly charity drive and seminars for learning. In addition to that, He is actively involved in community service, volunteering with local youth programs to promote sportsmanship and healthy living among younger players. He has also served as the captain of his basketball team, leading by example both in practice and during games.

EDWIN JR. J. CUBIAN is a 4th year student pursuing a Bachelor of Science in Air Transportation at PATTS College of Aeronautics. With a strong passion for the aviation industry, he focuses on aviation safety protocols, flight planning, and flight operations. He is currently working on a thesis titled "Assessment of Bird Repellent Equipment in Aviation: A Focus on In-flight Systems," which explores bird-repellent devices in flight to reduce bird strikes while flying. Through this thesis, he aims to contribute valuable insights that will help others soon. Aside from academics, he enjoys being active in his daily life, he likes to play basketball and work out regularly to maintain his physical fitness. His enthusiasm for aviation is very high, and he aspires to pursue a career as a flight dispatcher or an air traffic controller.

REY JUSTIN F. DAAYATA is the only son of Mr. Rey B. Daayata and Mrs. Clotilde F. Daayata and was born on August 13, 2001, in Cagayan de Oro City. He finished his elementary years at Lourdes College Grade School and continued with his junior and senior high school at St. Mary's School and graduated with honors on both rites. He studied for 2 years at UP Los Baños but decided to change his course and pursue his dream, the reason why he is recently a fourth-year student at PATTS College of Aeronautics, taking up Bachelor of Science in Air Transportation. A devoted and compassionate individual, he has been an altar server since his elementary years reflecting his strong faith and kind-hearted nature. Despite life's challenges, his determination has never wavered. He remains committed to his goal of becoming a successful pilot, refusing to let financial difficulties stand in the way.

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LIANNE KRISHA M. DELA CRUZ is a fourth-year student who is pursuing a degree of Bachelor of Science in Air Transportation. She is a dedicated student leader who received two medals in senior high school for her service as part of the Student Buddies program. She has consistently held leadership positions since elementary school, serving as a former President in high school and as the Bachelor of Science in Air Transportation Representative in the PATTS Student Council during A.Y. 2023–2024. Currently, she serves as the Vice President of the PATTS Elite Gamers Association. In addition to that, she is also an exceptional student who has consistently demonstrated academic excellence throughout her high school years. She has been recognized with multiple awards for being the best in class, a testament to her dedication, hard work, and commitment to learning. Beyond her accomplishments, she credits her values and determination to her loving and humble family, who serve as her constant source of support and motivation. She also acknowledges that putting God first in all things has been key to her achievements, guiding her to stay grounded and focused on her goals.

MATTHEW NICHOLAS B. ESPARES is a fourth-year student pursuing a degree in bachelor of science in Air Transportation. Was born in the Philippines and lived for 1 year before moving to Dubai UAE and lived throughout his middle and high school years studying in a British curriculum, Throughout his high school years, he gained proficiency in public speaking as a part of the debate team in his highschool and hosted events as a youth leader. As a hardworking student, he has put himself to aiding in community service and worked as a youth leader in Youth For Christ. In addition to his education, he has also developed additional skills relating to graphic design as well that aided in marketing groups for his work experience, gaining an insight into project management and negotiation.

RUZLE A. SULDAN, is a fourth-year student at PATTS College of Aeronautics. Her creative abilities have been evident since elementary school, and she continues to excel in both academic and extracurricular activities. Passionate about her future profession, she actively participates in seminars and events related to aviation. She is also a committed member of the Community of Youth for Christ, where she engages in various community outreach activities. Aside from her studies, she has a strong passion for content creation and enjoys sharing her experiences and ideas. As the only member of her family pursuing an aviation career, she's determined to become a pilot and make a meaningful impact in the field**.**