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Automated prayer broadcasting system using Arduino Uno R3 for religious institutions

Fuentes, Ayecelle C. ✉
Divine Word College of San Jose, Philippines (ayecellefuentes23@gmail.com)
Barolo, Micco Andrei A.; De Vera, Kamill Crysia M.;
Escalona, Mariella A.; Fabrigas, Princess Liegh R.;
San Juan, Princez Charmelle R.; Javier, Christian Jacob P.;
Panganiban, Maeden G.; Go, Thomas Edward S.;
Dablo, Imarie O.; Valdez, Erna Joy T.

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Abstract

This study aimed to produce an automated prayer broadcasting system using Arduino Uno R3, designed for religious institutions. This focused on addressing three main research questions: the level of extent of the system in terms of range and durability; its performance in terms of volume, clarity, and accuracy; and whether there is a significant difference between the automated system and manual operation. The researchers themselves served as the respondents in evaluating the system. An applied research design was used, and the study employed observation and data gathering through a structured evaluation tool. Data were analyzed using statistical methods, specifically the weighted mean and analysis of variance. The findings revealed that the Automated Prayer Broadcasting System was rated from high to very high in terms of range and durability. In terms of performance, the system demonstrated reliable volume output, clarity of sound, and accuracy in delivering scheduled prayers. The T-test results showed a significant difference between the automated system and manual operations, confirming the efficiency and reliability of the automated broadcasting system. Based on these findings, the study concluded that the system is an effective and practical solution for religious institutions seeking consistent and automated prayer reminders. The study recommends further improvements, such as integrating backup power systems for reliability and expanding the range for larger areas. Future researchers may explore enhancing the system's features and applying it to other settings beyond religious institutions.

Keywords: Arduino Uno R3, automated prayer broadcasting system, religious institutions, prayer reminder system; applied research

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1. Introduction

In recent years, embedded systems and automation advancements have produced numerous applications to simplify everyday tasks. One is the automation of religious practice, such as prayer broadcasting. Historically, prayer calls (Angelus) or other religious broadcasts are made manually or with simple loudspeaker systems. However, with the advent of microcontrollers and open-source platforms like Arduino, there is an opportunity to produce automated systems to accomplish this task. The Arduino Uno R3, which is a popular microcontroller platform, can be used in such projects since it is easy, versatile, and easy to integrate with many sensors, clocks, and audio systems, as highlighted by Beagle (2021). Further, Gupta and Saini (2021) noted that using Arduino to create an automated prayer call broadcasting system is inexpensive and provides an individualized platform for personal use and religious institutions. Thus, these systems can ensure that prayer calls are aired at the exact times, without human interference and frequent manual input. Through real-time clocks (RTC), such a system can follow rigid schedules for prayer times, particularly in religious rituals where timing is essential.

Furthermore, the broadcasting system can support varying prayer times so that the appropriate audio file is played based on the time of day. Therefore, this research aims to develop an automated prayer broadcasting system based on Arduino Uno R3 for religious institutions. The audio will be capable of being played at predetermined times, equating to differing prayer intervals with little human intervention. The audio will be capable of being played at predetermined times, equating to differing prayer intervals with little human assistance. Despite all these developments, research on microcontroller-based automated prayer broadcasting systems is still not extensive. Specifically, the majority of the solutions nowadays are single-purpose ones that lack flexibility and adaptability. Thus, newer systems cannot support different prayer lengths, orders, or religious settings. Additionally, they lack real-time updating. This research aimed to create a more sophisticated and flexible automated prayer broadcasting system to overcome these limitations.

Statement of the Problem - This study aimed to produce an automated prayer broadcasting system for religious institutions using Arduino Uno R3. Specifically, this study aimed to answer the following questions: (1) What is the performance level of the Automated Prayer Broadcasting System in terms of range, durability, volume, clarity, and accuracy? (2) Is there a significant difference between the Automated Prayer Broadcasting System using Arduino Uno R3 for Religious Institutions and manual operations?

Significance of the Study - This research aims to produce an automated prayer broadcasting system using Arduino Uno R3, which is intended to improve the efficiency and accessibility of religious activities in institutions. The researchers believe the study's outcome can significantly benefit religious institutions. By using the Automated Prayer Broadcasting System with Arduino Uno R3, religious institutions can ensure that prayer times are announced accurately and consistently without relying on manual operation. Students: This study will allow students to learn more about how automated systems work, especially using Arduino, and get a chance to build a computerized prayer broadcasting system, helping them apply what they know in an actual project. Staff and School Administrators: By scheduling prayer automatically, administrators do not have to deploy staff to start prayers manually, thus saving them time and enabling them to attend to more pressing duties. The precise timekeeping offered by the system allows teachers to coordinate their class timings, avoiding delays or confusion when switching between lessons and prayer periods. Future Researchers: The research results can be used as a reference or guide for future researchers who want to conduct similar research on automated systems or Arduino projects.

Scope and Delimitation of the Study - This experimental study was developed and tested in the school year 2024-2025. The study's primary objective is to produce a system that automates the daily prayer period in schools.

The researchers tested the functionality of an automated prayer broadcasting system study using Arduino Uno R3 in Divine Word College of San Jose (DWCSJ). It would not include mobile or internet controls and would target only the prayer broadcasting system. The study does not cover school broadcasts other than those for learning tasks, such as the Galaw Pilipinas exercise or playing the National Anthem, which falls outside what the system can do. This research focused entirely on automating the daily prayer broadcasts.

2. Methodology

Research Design - This research employed an applied experimental and quantitative research design to develop an automated prayer broadcasting system using Arduino Uno R3 for religious institutions. The research process entailed prototyping and iterative testing to enhance the system based on observed outcomes. By implementing these procedures, the study worked to secure the establishment of a stable and efficient broadcasting system while delivering measurable data to verify its results. Through this mixed strategy, the researchers were able to gain a complete understanding of the system's effect and operation in actual implementations.

Data Gathering Procedure - The researchers first identify the technological requirements for developing an efficient prayer broadcasting system based on Arduino Uno R3 for religious institutions. This involved figuring out user preferences for broadcast range, volume, durability, clarity, and accuracy and studying the advantages of combining an Arduino Uno R3-based system with a speaker, real-time clock (RTC), and power sources. In addition, sustainability, such as appropriate volume, distance range, and potential noise interferences, is investigated to ensure system dependability and clarity. To gather the needed information, direct observation and surveys were conducted to evaluate audio quality, determine the performance level, test the significant differences, and identify specific features that users might find helpful. The researchers sought assistance from experts in science and technology to validate the instrument and gather complete technical information about implementing an Arduino Uno R3 system, including its hardware and software components. This comprehensive data collection approach gathered critical user and technical requirements for successfully creating the Automated Prayer Broadcasting System using Arduino Uno R3 for religious institutions. Lastly, ten randomly selected participants among the researchers' classmates were asked to answer the validated survey questionnaires to evaluate the performance of the device. It took 2 days to finish the testing period and gather data.

Research Process: Stage 1 Preparation and Gathering of Materials - Researchers used the following materials, which have been selected from affordably priced materials and credible sources online: For Automated Prayer Broadcasting System housing: Chessboard Box, Dome Head Screw; For the Automated Prayer Broadcasting System: Arduino Uno R3, Bread Board, Jumper Wires, LCD, MP3 TF Module, DS1302 Real-time Clock, SD Card, Speaker

Stage 2: Building and Development of the Project - The researchers followed different steps in constructing and producing the product. These were the following: buying and completing the materials needed, assembling the system, securing connections, programming the Arduino Uno R3, and testing the product. These were involved in constructing and producing the product assemblage of the Automated Prayer Broadcasting System for a religious institution using Arduino Uno R3. Each element was then meticulously assembled and connected to guarantee correct system integration. The product's function was the Automated Prayer Broadcasting System, which used Arduino Uno R3 for religious institutions. After that, every connection was tightened to guarantee it was correctly connected to the Arduino Uno R3 for the best performance. Following the program's encoding into the system, functionality tests were carried out to ensure the final product performed as planned. It took a month to code and develop the device.

Stage 3: Experimental Stage, Observation, and Data Recording - The researchers conducted five trials on the range, durability, volume, clarity, and accuracy of the Prayer Broadcasting System. The researchers initially tested whether the Automated Prayer Broadcasting System was properly programmed to broadcast audio at a programmed time, testing the response time as well as the clarity of the audio output. Secondly, the researchers

checked the broadcast area and volume to ensure it covered the specific location. Also, the researchers tested the component durability of the system to ascertain that the system is stable and can endure repetitive use in school settings. Lastly, the researchers checked the simplicity of use by users to provide instant design assistance.

This study's data collection process and observation were multi-faceted to cover data comprehensively. The researchers first developed a structured questionnaire and validated it with the experts in science and technology before it was filled out by ten (10) randomly selected participants in their section. Second, data were collected through the researcher's direct observation to verify the system's performance regarding range, longevity, volume, clarity, and accuracy. Upon data collection, researchers made comparisons between results that would prove helpful when examining the system's efficiency and pointing out areas where improvement is needed. By combining these methods, the research team aimed to develop a thorough understanding of the system's impact on the school community and its potential for future use or production.

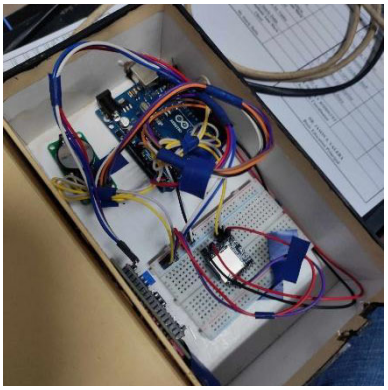

Figure 1. Final assembly of the Automated Prayer Broadcasting System Using Arduino Uno R3 for Religious Institutions

Statistical Treatment of the Data - In analyzing the Automated Prayer Broadcasting System using Arduino Uno R3 for Religious Institutions, the weighted mean and T-test were used to identify the difference between the Automated Prayer Broadcasting System and the existing manual operations. Moreover, the results produced a p-value, which is the significance level. A p-value less than 0.05 indicates a statistically significant difference between the two methods, meaning that the automated system performs better than manual operations.

3. Results and Discussions

Table 1 presents the range of automated prayer broadcasting systems with Arduino Uno for religious institutions. Most responses are clustered around a score of 3.0, indicating consistent performance in broadcasting audio over a significant distance. This shows that respondents gave satisfactory ranges for the system. The composite mean is 2.94 and is "high," showing that the system broadcasts audio quite efficiently over a high range of distances. Variations, however, show potential areas for improvement in range consistency. This is reinforced by Pennig et al.'s (2014) study, which placed great significance on speaker clarity and sound dispersion in large spaces to guarantee audibility even from a distance. The system can also produce a firm and unbroken broadcasting signal, as indicated by the highest weighted mean of 3.20, which corroborates the observation of Deng et al. (2020) in pointing out the efficiency of the DFPlayer Mini in providing optimized audio output.

Table 1

Performance Level of Automated Prayer Broadcasting System using Arduino Uno R3 for Religious Institution in Terms of Range

Indicators (Range)	Weighted Mean	Verbal Description
1. Speakers provide sounds even at a distance.	2.80	High
2. Speakers provide sound even in the specified frequency range.	3.00	High
3. The speakers effectively distribute sound across the intended area.	2.90	High
4. The system maintains consistent audio quality at different distances.	2.80	High
5. The broadcasting signal remains strong and uninterrupted across the designated coverage area.	3.20	High
Composite Mean	2.94	High
Indicators (Durability)		
1. Female-to-female jumper wire cable allows for easy circuit changes as needed.	3.20	High
2. Male-to-male jumper wire cable allows for easy circuit changes as needed.	3.40	Very High
3. Arduino Uno R3 is complete, breadboard-friendly, and maintains stable performance.	3.40	Very High
4. The wiring and Arduino Uno R3 remain stable and secure during prolonged operation.	3.20	High
5. The SD card consistently plays the audio without errors, even after extended use.	3.20	High
Composite Mean	3.28	Very High

Legend: *1.00-1.74 Low; 1.75-2.49 Moderate; 2.50-3.24 High; 3.25-4.00 Very High

In addition, Table 1 shows the level of durability of the Automated Prayer Broadcasting System with Arduino Uno for Religious Institutions, weighted mean and descriptive statistics, and a composite mean of 3.28, falling under the category of "Very High." The very high range shows a low concentration, with most scores between 3.2 and 3.3. The description "more" is somewhat unclear but probably indicates this range's most commonly provided rating. It is explained by Sharkawy et al. (2022), who highlighted the stability and effectiveness of Arduino Uno R3 in several automated systems. The findings support the conclusion that the system performs outstandingly well in clarity, volume, and range in all scenarios, helping the general good ratings in the figure. As Deng et al. stated, it is revealed that the system has super durability that can make it usable for a very long time, indicative of the effectiveness of the DFPlayer Mini and SD card modules in delivering stable audio.

Table 2 shows the performance level of the automated prayer broadcasting system using Arduino Uno R3 for a religious institution regarding volume, clarity, and accuracy. The composite mean of 2.86, "high," signifies that the system's sound output is clear and constant. However, measurement variations indicate improvement opportunities, especially in volume control as a function of the environment. This aligns with the findings of Gupta and Sharma (2019), who highlighted the effectiveness of quality speaker integration with microcontroller-based systems in delivering clear sound output. Moreover, the lowest mean of 2.6 indicates fewer occurrences for lower ratings. The cumulative % line rises incrementally along with increasing performance levels, a function of global system consistency. The MP3 TF module, according to Deng et al. (2020) and Schéma (2020), ensures smooth and precise audio output, enhancing the system's dependability.

Moreover, regarding clarity, Table 2 displays a composite mean of 3.12 under the "High" category, representing that the system produces clear sound output effectively. Despite this, the deviation of individual indicators suggests room for improvement. The LCD received a very high rating (3.60), confirming its

usefulness in showing the proper prayer schedule and system status—an essential feature supported by Tan et al. (2024), who emphasized the contribution of Arduino Uno R3 in optimizing display functions in STEM projects. In addition, the lowest mean of 2.5 indicates that speakers provide sound even within the specified range. This finding aligns with Panetta et al. (2018) and Pennig et al. (2014), who highlighted the significance of audio clarity in broadcasting systems for successful communication. Additionally, these findings indicate that most users find the system reliable in providing clear audio. This supports Deng et al.'s (2020) findings on the MP3 TF module's role in maintaining clear playback in audio broadcasting systems.

Table 2

Performance Level of Automated Prayer Broadcasting System using Arduino Uno R3 for Religious Institution in Terms of Volume, Clarity, and Accuracy

Indicators (Volume)	Weighted Mean	Verbal Description
1. Speakers provide sound clearly, even at maximum volume.	2.80	High
2. The speakers effectively distribute sound across the intended area.	2.90	High
3. The system maintains consistent volume across all scheduled prayers.	3.10	High
4. The speaker boosts sound output effectively without distortion.	2.90	High
5. The system allows volume adjustment to suit different environments.	2.60	High
Composite Mean	2.86	High
Indicators (Clarity)		
1. Speakers provide sound even within the specified range.	2.50	High
2. The LCD shows the correct prayer schedule and system status.	3.60	Very High
3. The system does not produce unwanted noise or interruptions during playback.	3.20	High
4. Audio output remains clear even when played for extended periods.	3.20	High
5. The wiring and connections prevent signal interference, ensuring clear sound.	3.10	High
Composite Mean	3.12	High
Indicators (Accuracy)		
1. The real-time clock provides accurate time.	3.70	Very High
2. The SD card consistently plays the audio without errors.	3.40	Very High
3. The system plays the prayer on time as scheduled.	3.60	Very High
4. The system does not skip any scheduled prayers.	3.60	Very High
5. The automated system correctly follows the set prayer schedule without manual intervention.	3.50	Very High
Composite Mean	3.56	Very High

Legend: *1.00-1.74 Low; 1.75-2.49 Moderate; 2.50-3.24 High; 3.25-4.00 Very High

Lastly, the composite mean of 3.56, "Very High," shows that the system consistently broadcasts accurately. This suggests the system efficiently maintains the correct schedule for broadcasting prayers without manual operation. The real-time clock (RTC), scoring an average of 3.70, plays a significant role in ensuring proper timing, in line with Maleki (n.d.), who emphasized the reliability of the DS1302 RTC module for time-critical microcontroller-based applications. The smooth playback of audio tracks using the SD card module (mean of 3.40) commends Achcha (2021), who supported the reliability of the SD card module in storing and retrieving data in automated systems.

Table 3 summarizes the indicators' range, durability, volume, clarity, and accuracy. Accuracy obtained the highest average rating of 3.56 among these indicators, with the most significant variance of 0.309, suggesting high performance but with a broader range of responses. Durability is subsequent, with a mean of 3.28 and the most minor variance of 0.099, proving consistently high ratings for the system's strength. Volume has the

lowest mean at 2.86 with a variance of 0.178, implying potential for slightly stronger audio output. These results are backed by Maleki (n.d), which places stress on the functionality of precise timekeeping parts such as the DS1302 RTC in making systems more accurate, and that of Donoso and Ladera (2015), which focuses on the functionality of long-lasting wiring and parts in ensuring system longevity and dependability.

Table 3

Summary Results of Performance level

Indicators	*Count*	*Sum*	*Average*	*Variance*
Range	10	29.4	2.94	0.151
Durability	10	32.8	3.28	0.099
Volume	10	28.6	2.86	0.178
Clarity	10	31.2	3.12	0.108
Accuracy	10	35.6	3.56	0.309

Table 4

Difference Between Automated Prayer Broadcasting System using Arduino Uno R3 for Religious Institutions and Manual Operation

Source of Variation	df	F value	P-value	Interpretation
Automated Prayer Broadcasting System using Arduino Uno for Religious Institutions→Manual Operation	4	4.635	0.003	Significant

Legend: *P-value ≤ 0.05 = Significant; Ho rejected

Table 4 shows the statistical analysis of the difference between the automated prayer broadcasting system using Arduino Uno R3 for religious institutions and manual operation. The research provided an F-value of 4.635 and a P-value of 0.003, both lower than the 0.05 significance level, indicating the presence of a significant difference and forcing the rejection of the null hypothesis (Ho). This means the automated system functions better than human operations regarding broadcasting prayers. The improved performance can be attributed to the system's ability to deliver consistent, timely, and accurate prayer broadcasts without relying on human intervention, which is often subject to fatigue, inconsistency, or scheduling conflicts. This result agrees with the research conducted by Sharkawy et al. (2022), which emphasizes using Arduino Uno R3 in automating systems for increased accuracy and dependability in innovative applications. Additionally, the significant results align with Tan et al. (2024), who emphasized the role of Arduino Uno R3 in improving operational efficiency and reducing human error in automated systems.

4. Conclusions

Based on the summary of findings, the following conclusions were made concerning the research problems stated: The extent of the Automated Prayer Broadcasting System using Arduino Uno R3 for religious institutions in terms of range and durability is evaluated as high to very high. The performance level of the Automated Prayer Broadcasting System using Arduino Uno R3 for religious institutions is generally high in volume, clarity, and accuracy. There is a significant difference between the automated prayer broadcasting system using Arduino Uno R3 and manual operation in terms of performance and reliability.

Recommendations - Based on the findings of this research, the following recommendations are made: To increase the performance of the developed product, future developers may use higher-quality amplifiers to cover larger areas effectively. Developers may add advanced audio processing technology to further improve the system's performance to heighten sound clarity, reduce distortion, and maintain consistent audio levels. The researchers suggest that future researchers include redundancy features, like backup power supplies or a dual

broadcasting setup, to avoid downtime during power outages and improve system reliability.

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