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PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIICaS 2024)



*“Flourish and Nurturing Sustainable
Innovation for a Prosperous Nation”*

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e ISBN: 978-967-0033-25-9



**Published in Malaysia by
Universiti Teknologi MARA Cawangan Johor
Kampus Pasir Gudang
81750 Masai**



Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector



Assalamualaikum warahmatullahi Wabarakatuh,
Salam Sejahtera, Salam Malaysia MADANI and
Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most
Merciful.

It is a great honor to welcome you to the Johor
International Innovation, Invention, Competition, and
Symposium 2024 (JIICaS 2024). This event

connects various disciplines, focusing on education and engaging educators,
students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and
determination to turn those ideas into reality. The remarkable projects
showcased today highlight the dedication and spirit of all participants.
Initiatives like this not only explore new technologies but also cultivate skills
and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor
Branch, we are fully committed to fostering a dynamic culture of innovation,
promoting the commercialization of new products, and encouraging
meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all
sponsors, judges, the College of Computing, Informatics and Mathematics,
UiTM Pasir Gudang Campus as the event organizer, as well as to the
researchers and participants for their hard work in making this event a
success. Let us continue striving for innovation and excellence. May the
ideas presented today inspire us and lay the groundwork for future
achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-ST170) DISCOVERING SHAPES: A SHAPE LEARNING SYSTEM FOR YOUNG CHILDREN

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ABSTRACT

This project focuses on the development of an interactive shape learning system specifically designed for early childhood education. The system aims to address the challenges associated with traditional methods of teaching shapes, which often fail to engage young learners and can lead to inaccuracies in their understanding of geometric concepts. The project seeks to create a user-friendly application that not only enhances children's learning experiences but also provides accurate shape detection using image processing techniques. The background of the problem lies in the limitations of conventional shape learning tools such as physical toys and books, which can be costly, require significant resources, and may contain inaccuracies that impact children's long-term understanding of shapes. Traditional educational methods often struggle to maintain the interest of young learners, leading to suboptimal educational outcomes. Additionally, there is a growing need for integrating technology into early education to make learning more interactive and engaging. The primary objective of this project is to develop a robust and interactive shape learning system for children aged 4 to 6. This system aims to enhance engagement and learning outcomes by providing an interactive platform that combines shape learning modules, quizzes, and real-time shape detection. The proposed system utilizes the latest advancements in image processing to provide an accurate and efficient tool for shape education. To achieve this objective, the system is designed to include three main modules: Learn Shape, Quiz, and Detect Shape. The Learn Shape module introduces children to various geometric shapes through interactive lessons. The Quiz module tests their understanding and retention of shape concepts through engaging and age-appropriate questions. The Detect Shape module uses image processing techniques, such as edge detection and contour analysis, to identify and classify shapes in real-time using the device's camera. This module enhances the learning experience by allowing children to interact with their environment and apply their knowledge practically. In conclusion, this project contributes to the advancement of educational technology by providing a practical and innovative solution for shape learning in early childhood education. By integrating interactive modules and accurate shape detection, the system not only improves the efficiency and effectiveness of shape education but also makes learning fun and engaging for young children. This project showcases the potential of combining educational strategies with technology to create meaningful and impactful learning experiences for children.

Keywords: Interactive shape learning, Early childhood education, Image processing, Geometric concepts, Educational technology.

INTRODUCTION

This project focuses on the development of an interactive shape learning system tailored for early childhood education. It aims to overcome the limitations of traditional methods, which often fail to engage young learners and can be both costly and resource-intensive. Traditional tools, such as shape toys and educational booklets, are expensive, require substantial physical resources, and often lack the interactivity needed to maintain the attention and motivation of young children. Additionally, these methods demand considerable preparation from educators and parents, making them inefficient and difficult to scale.

The goal of this project is to create a cost-effective, engaging, and resource-efficient shape learning system for children aged 4 to 6. By utilizing technology, specifically Android devices, the system will offer interactive learning modules, quizzes, and real-time shape detection.

To achieve these objectives, the project has outlined specific goals. The first goal is to analyse various shape learning methods to understand user needs, enabling the development of effective educational modules. Second, design and develop an interactive, user-friendly shape learning system that includes features like interactive shape learning, quizzes, and a shape detection module. Finally, the performance of this system will be evaluated through comprehensive testing and feedback from users, ensuring it meets the educational needs of young children.

The scope of the project is clearly defined, with the primary target users being children aged 4 to 6. The content will be developed in English to ensure broad accessibility. The system will focus on teaching four basic shapes: circle, triangle, square, and rectangle. It will be developed exclusively for Android devices, taking advantage of their widespread use and accessibility. The system will include several modules, such as an interactive shape learning module, a quiz module for reinforcing knowledge, and a shape detection module that enables real-time interaction with the environment.

The significance of this project lies in its potential to revolutionize shape learning by providing a personalized, engaging, and accessible platform that supports early skills development. By integrating technology into the learning process, the project aligns with current trends in educational technology, demonstrating how innovative approaches can enhance traditional learning methods.

METHODS

The methodology employed in the development of the "Discovering Shapes" system follows a structured approach based on the Waterfall Model, a traditional software development process. This model was selected due to its sequential nature, which ensures that each phase is completed before the next one begins, thereby reducing the likelihood of errors and ensuring a clear progression from concept to deployment (Carlos A. Crespo-Santiago et al.,

2022). The key phases include requirement analysis, design, implementation, testing, and deployment & maintenance. The Waterfall Process software development life cycle is depicted in Figure 1.1.

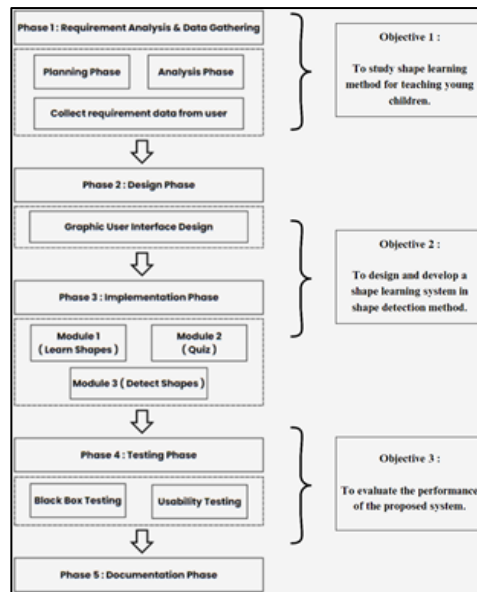


Figure 1 Phase of Waterfall Process

In the requirement analysis phase, the needs of the system were carefully identified, focusing on the development of interactive modules and the incorporation of real-time shape detection capabilities. The design phase involved planning the system's architecture, with a particular emphasis on the user interface and the integration of image processing techniques necessary for shape detection. During the implementation phase, the actual coding of the system took place, ensuring that the interactive features were effectively integrated with the shape detection module. This was followed by the testing phase, where the system's functionality, usability, and accuracy—especially in shape detection—were thoroughly evaluated to ensure that it met the project objectives. Finally, the deployment & maintenance phase involved launching the system and providing updates as needed to ensure its continued effectiveness and relevance.

A key component of the system is its ability to detect shapes in real-time using a contour-based method. Contours are essentially curves that join all continuous points along a boundary that share the same color or intensity. By detecting these contours, the system can identify geometric shapes based on their boundary properties (Grigorescu, C., Petkov, N., & Westenberg, M. 2003). This method is particularly effective in accurately recognizing shapes, which is crucial for an educational tool aimed at young children. To implement this contour-based detection, OpenCV—a powerful tool for real-time image processing—was employed. The image processing workflow begins with converting the captured image to grayscale, which simplifies the image by reducing it to shades of gray. Following this, a binary threshold is applied, which differentiates the shapes from the background by converting the image into a binary format. OpenCV's findContours function is then used to detect the contours within the image. Finally, the system identifies the shape by analyzing these contours and comparing them to predefined geometric models, ensuring accurate shape

recognition (J. Sigut, Miguel Castro, R.Arday, and M. Sigut, 2020). The combination of the contour-based method and OpenCV ensures that the "Discovering Shapes" system is both efficient and effective in real-time shape detection, significantly enhancing the learning experience for young children by making it interactive and engaging.

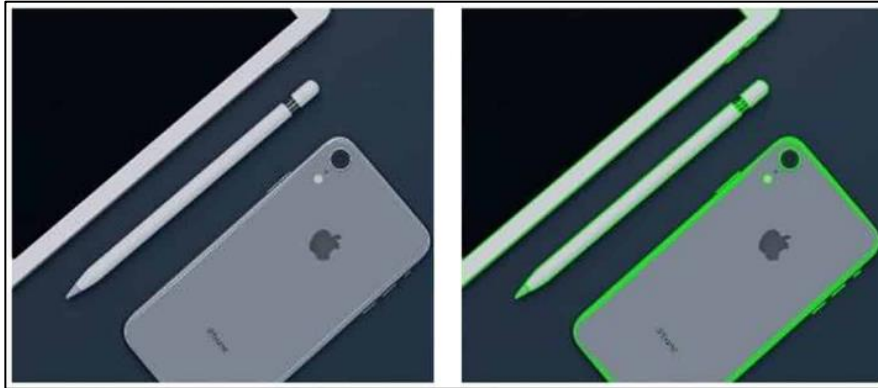


Figure II Example of Image After Applying Contour Based Detection

System requirements are critical to ensure the smooth development and functioning of the shape learning system. These requirements are divided into two main categories: hardware and software. The purpose of specifying these requirements is to outline the necessary tools and resources needed for the development, testing, and deployment of the system. The hardware requirements are essential to provide the computational power and resources needed for running the development tools, processing images, and testing the application. The specified hardware ensures that the system can handle the demands of real-time image processing and shape detection, which are computationally intensive tasks. The software requirements encompass the operating system, development platforms, and programming languages that will be used to build the system. These software tools are chosen to provide a robust and efficient development environment, enabling the creation of a reliable and high-performance shape learning application. The following tables list the detailed hardware and software requirements for the project:

Table I The Hardware Requirement

Hardware	Model / Version
System Model	MSI GF66 KATANA
Central Process Unit (CPU)	11th Gen Intel(R) Core (TM) i7-11800H @ 2.30GHz 2.30 GHz
Random Access Memory (RAM)	16.0 GB
Graphic Processing Unit (GPU)	NVIDIA GeForce RTX 3050 Ti

Table II The Software Requirement

Software	Model / Version
PC OS	Windows 11 with 64-bits
Application Development Platform	Android Studio, OpenCV
Language	Java

RESULTS AND DISCUSSION

The testing phase of the "Discovering Shapes" system was crucial in ensuring that the application met user requirements and maintained high quality. Two primary testing methods were employed: Black Box Testing and Usability Testing.

Black Box Testing focused on verifying the system's functionality without considering the internal code structure. The test cases covered various features, including the sign-in process, main menu navigation, learning modules, quiz functionality, and shape detection. The results demonstrated that all features performed as expected, with all test cases passing successfully. For instance, the system accurately detected and highlighted shapes like circles, squares, rectangles, and triangles, and the navigation between modules was seamless and error-free. This confirmed that the system's functionality aligned with the specified requirements, enhancing its reliability and usability.

Usability Testing evaluated the user-friendliness and overall experience of the system. Feedback from participants, particularly young users, indicated strong satisfaction with the application. The interface was found to be intuitive, and the interactive features, such as shape detection and quizzes, were both engaging and educational. The majority of respondents rated the navigation, functionality, and overall user experience highly.



Figure III Result of the open-ended section.

Moreover, the usability testing included an open-ended section where users could provide additional comments or suggestions and the result is on the figure III above. Out of the responses received, several users offered specific ideas for enhancing the application, such as introduce additional fun activities into the system to attract and engage children, making the learning experience more enjoyable. These constructive suggestions are valuable for future iterations of the system. Additionally, some users expressed overall satisfaction, indicating that the application already functions well as it is. Figure IV below shows the user that is young children is using the application.



Figure IV User using the “Discovering Shapes” application

CONCLUSIONS

The project successfully developed an early educational tool for shape detection, meeting the intended objectives by creating a system that accurately identifies and classifies shapes. To further enhance the system, recommendations for future improvements include refining the user experience with age-appropriate quizzes, increasing shape detection accuracy, and incorporating interactive activities. Additionally, integrating a database for personalized learning and providing detailed insights for parents and teachers are suggested to enhance the system's effectiveness and impact on early childhood education.

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