ISSN (e): 2250 – 3005 || Volume, 16 || Issue, 5 || May – 2026 ||
International Journal of Computational Engineering Research (IJCER)

Design and Development of an Android-Based Complex Number Calculator

Putut Son Maria[1]
[1] Department of Electrical Engineering, Faculty of Science & Technology, Sultan Syarif Kasim Riau State Islamic University, Pekanbaru, Riau, Indonesia.

ABSTRACT
Mobile learning tools have become a practical way to make abstract topics more approachable, and Android applications are especially useful for helping students understand complex numbers. Concepts like imaginary units, Argand diagrams, and polar forms can feel disconnected from intuition when presented only through textbooks. An interactive app can visualize these ideas—showing how a number moves on the complex plane or how multiplication affects magnitude and angle—turning something abstract into something students can see and manipulate. However, students often face several problems when learning complex numbers. First, the transition from real numbers to imaginary values can be confusing, especially when they cannot relate it to real-world examples. Second, many learners struggle with operations such as converting between rectangular and polar forms or understanding Euler's formula. Third, traditional teaching methods may not provide enough immediate feedback, leaving misconceptions uncorrected. The objective of this study is to build an Android application to provide students with an accessible and interactive platform for learning anytime and anywhere. It aims to simplify complex concepts through visualizations, guided exercises, and immediate feedback to improve understanding. Additionally, the application seeks to increase student engagement and motivation by incorporating interactive and user-friendly features.

Keywords: *Android App, Complex Number, Calculator.*

Date of Submission: 05-05-2026 Date of acceptance: 16-05-2026

I. INTRODUCTION

A course in complex variables holds a vital place in university education, particularly for students in mathematics, physics, and engineering. Unlike real-variable calculus, the study of complex variables introduces functions of complex numbers, revealing elegant structures and powerful results that often simplify otherwise difficult problems. One of the key reasons this course is important is its wide range of applications. Complex analysis is fundamental in fields like electrical engineering(helfy-algoritma), fluid dynamics, quantum mechanics, and signal processing.

Techniques learned in the course can be used to evaluate real integrals, solve differential equations, basic geometry[1] and model physical phenomena more efficiently than with real-variable methods alone. This makes the subject not only theoretically rich but also highly practical[2][3]. A complex variables course should equips students with both the theoretical foundation and practical tools needed to tackle sophisticated problems, such as computer softwares[4][5] or application runs on mobile gadget[5-10]

However, most computer software often requires bulky hardware and considered to be impractical for student to carry a computer or laptop during the class, otherwise some android applications compel for internet connection and frequently display annoying advertisements[11][12]. This is normal for demo version of a computer software or free version of application, because software developers incur costs when developing their applications and users are required to purchase fully featured application to enable them using the apps conveniently. An Android application is typically designed to run within the Android runtime environment, relying on its specific APIs, libraries, and application lifecycle. Running such an application on platforms like Windows Phone or QNX[12]—each with their own distinct architectures—requires an adaptation layer or compatibility strategy rather than direct execution. Meanwhile, most of students often lack sufficient cash to purchase licensed apps or computer programs, in such way that this become unfavorable condition.

II. RESEARCH METHOD

a. Interface Design

Figure 1 shows diagram block of the application interface. The screen is divided into two main sections that organize user interaction and output clearly. At the top, there are two equal-sized rectangular areas placed side by side. These represent input options: one labeled "Rectangular Format entry" and the other "Polar Format entry." This horizontal segmentation allows users to choose between two different data input formats, suggesting a functional distinction while maintaining visual balance.

Below these input sections, there is a larger rectangular area spanning the full width of the layout. This section is labeled "Arithmetic Operation Result," indicating that it is dedicated to displaying the output after the user performs calculations based on the selected input format.

Overall, the design demonstrates a clear hierarchical structure: input options are grouped at the top for easy access, while the result area is emphasized with more space below. This segmentation improves usability by separating interaction zones (input) from feedback/output, making the interface intuitive and easy to navigate..

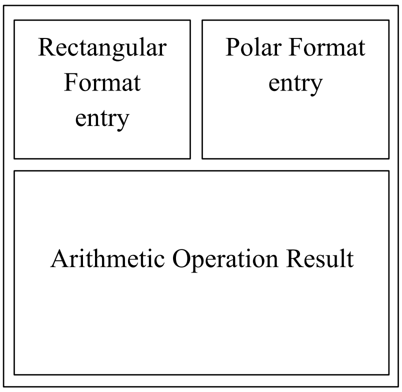


Figure 1. Interface Design

b. Complex Number Format

In mathematics, complex numbers are typically written in a standard form that makes them easy to interpret and manipulate. This format is expressed as a + i b , where a and b are real numbers, and *i* represents the imaginary unit defined by the property $i^2 = -1$. In this form, a is called the real part, while b is the imaginary part of the complex number. Writing complex numbers in standard form is important because it provides a consistent way to perform operations such as addition, subtraction, multiplication, and division. For example, when adding two complex numbers, it is simply done by combine their real parts and imaginary parts separately. This clarity also helps when comparing complex numbers or representing them graphically on the complex plane, where the horizontal axis corresponds to the real part and the vertical axis corresponds to the imaginary part.

In addition to the familiar rectangular form a + i b, complex numbers can also be expressed in polar form, which emphasizes their magnitude and direction rather than their horizontal and vertical components. In this standard format, a complex number is written as

$$Z = r (\cos \theta + i \sin \theta)$$

where r represents the modulus (magnitude or absolute value) of the complex number, and θ represents the argument (the angle measured from the positive real axis). The modulus r is always a nonnegative real number and is calculated using the distance formula:

$$r = \sqrt{a^2 + b^2}$$

while the argument θ is determined using trigonometric relationships such as $\tan \theta = \frac{b}{a}$, taking into account the correct quadrant of the complex number. In this study, the mandatory figures of the complex number that the user can enter are a and b if user wants to convert from rectangular to polar form, otherwise r and θ if the user wants to convert from polar to rectangular form.

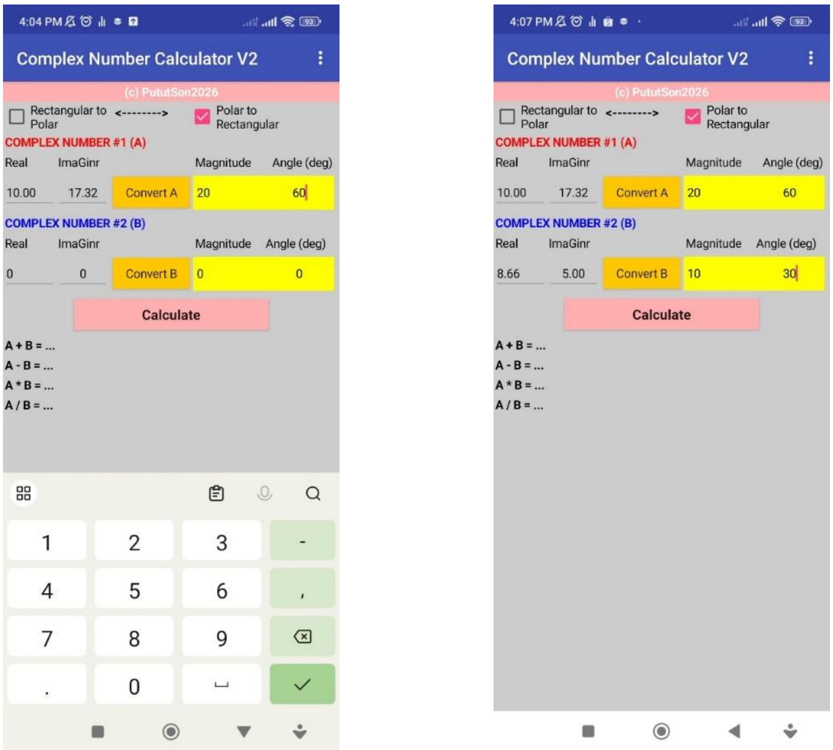
III. RESULTS AND DISCUSSION

a. Display and Accuracy

Figure 2.a and 2.b shows screen captured of the applications. The layout is clean and functional, with clearly labeled sections for inputting values in both rectangular form (real and imaginary parts) and polar form (magnitude and angle in degrees). A toggle option at the top allows the user to switch between “Rectangular to Polar” and “Polar to Rectangular,” with the latter currently selected.

In the first section (Fig 2.a), labeled “COMPLEX NUMBER #1”, the rectangular inputs are filled with 10.00 for the real part and 17.32 for the imaginary part, while the corresponding polar values—magnitude 20 and angle 60 degrees—are highlighted in yellow, indicating a successful or active conversion. A button labeled “Convert A” sits between these fields, suggesting the user can compute the equivalent form with a single tap. In the second section, “COMPLEX NUMBER #2” (Fig 2.b), the rectangular inputs are 8.66 and 5.00, which match a polar form of magnitude 10.00 and angle 30.00 degrees, again highlighted in yellow to indicate active or computed values.

Below the input sections, a “Calculate” button is prominently displayed, followed by placeholders for the results of operations such as addition, subtraction, multiplication, and division (A + B, A − B, A × B, A ÷ B). This setup improves reliability and simplifies maintenance or troubleshooting. Below these inputs, the app displays the results of operations between the two complex numbers. In Fig. 3 The sum (A + B) is shown as 18.66 + j(22.32), which is also expressed in polar form as approximately 29.09 at an angle of 50.10 degrees. The difference (A − B) is given as 1.34 + j(12.32), with a magnitude of about 12.39 and angle 83.79 degrees. For multiplication (A × B), the result is purely imaginary in rectangular form (0.00 + j200.00), corresponding to a magnitude of 200.00 and a right angle of 90 degrees. Finally, the division (A ÷ B) yields 1.73 + j1.00, equivalent to a magnitude of 2.00 and an angle of 30.00 degrees.



(a) (b)

Figure 2. Application Image

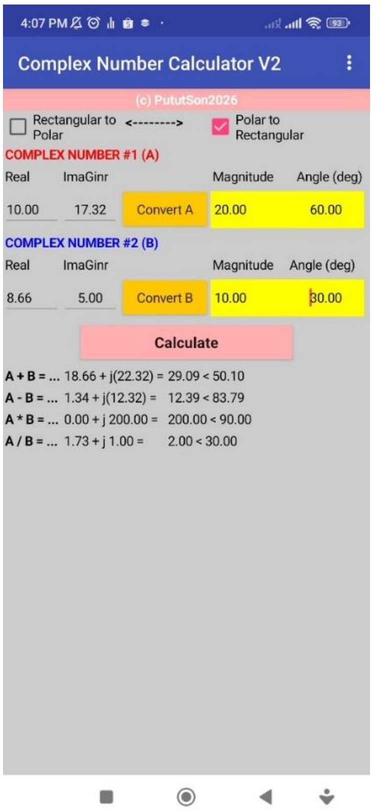


Figure 3. Result

Accuracy testing of this app is also compared to an online calculator (intmath.com). The comparison highlights strong consistency between the two systems. Both produce matching magnitudes, angles, and rectangular components, indicating that the calculator app is reliable. Additionally, while the mobile app emphasizes quick computation and usability, yet the graphical tool on the online calculator provides deeper insight by illustrating the geometry behind the numbers. Together, they complement each other—one offering efficiency, the other conceptual clarity.

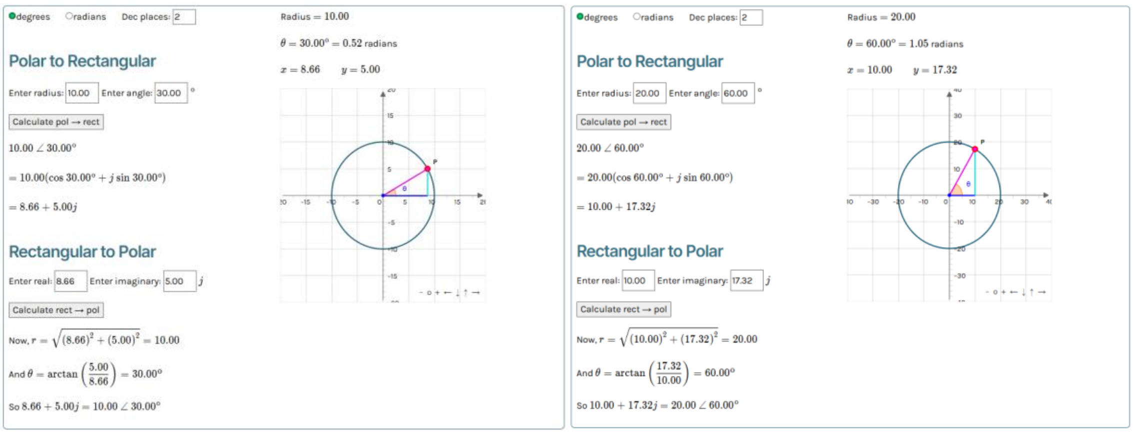


Figure 4. Result from online Calculator(intmath.com)[13]

b. User Experience and Feedback

The application developed in this study has been successfully installed and used by fourth-semester students in the Electrical Engineering program at UIN SUSKA RIAU. This group of students actively engaged with the app as part of their learning process, particularly in topics related to complex numbers. After using the application, they were asked to provide feedback based on their experience.

User feedback and comments were collected and are summarized in Table 1. The responses indicate a generally positive reception of the application among the students. Most of them reported that the app performs calculations accurately, producing results that align with theoretical expectations and manual computations.
In addition, many students found the application to be a helpful reference tool when working on complex number problems. It allowed them to verify their answers quickly and gain more confidence in their solutions. Overall, the feedback suggests that the application is both reliable and beneficial as a supporting tool in learning complex number arithmetic.

Table 1. Summary of user comments

Feature	Comments
Visual and Display Improvements	Multiple responses indicate the need for visual improvements, specifically suggesting adjustments to the color scheme (avoiding overly bright/striking colors), improving the display, and making the overall visual experience more comfortable for the user
Feature and Menu Expansion	Users requested adding more features and functionality, such as increasing the number of menu options, adding more shortcuts similar to built-in calculators (beyond just converting rectangular and polar forms), and providing a summary/conclusion for each calculation
Minor Technical and Usability Issues	Suggestions included improving the language presentation, addressing existing bugs, and making size adjustments
Positive Feedback	Several respondents stated that the application is good, very helpful, and that no improvements were necessary

IV. CONCLUSION

An Android-based app designed to assist with complex number calculations has been successfully developed. The results demonstrate satisfactory accuracy, and the app has been used by students to learn complex number arithmetic. the feedback highlights that the application is generally well-received and considered useful by its users, particularly in supporting complex number calculations. However, several areas for improvement have been identified. Enhancing the visual design—especially by refining the color scheme and overall display—would improve user comfort and experience. Expanding features and menu options would also increase the app's functionality, making it more comparable to standard calculator tools and more helpful for a wider range of tasks. Additionally, addressing minor technical and usability issues, such as language clarity and bug fixes, would further strengthen the application's reliability. Overall, while the application is already effective and appreciated by many users, implementing these improvements would make it more polished, user-friendly, and versatile.

REFERENCES

[1] D. Tristianto, L. Linawati, and B. Susanto, "Penerapan Bilangan Kompleks untuk Menyelesaikan Soal-Soal Geometri Datar," *Cartes. J. Mat. dan Apl.*, vol. 7, no. 1, pp. 8–14, 2018.

[2] N. Nuraina, R. Rohantizani, and S. Muliana, "Analisis Proses Berpikir Kritis Mahasiswa Dalam Menyelesaikan Soal Aljabar Bilangan Kompleks Berdasarkan Kemampuan Matematika," *Asimetris J. Pendidik. Matemtika dan Sains*, vol. 5, no. 1, pp. 47–54, 2024.

[3] A. M. Dewi, L. Khamdanah, L. Dalalah, and U. Mahmudah, "Exploration Of Complex Number Visualization In Julia Set-Based Fractal Geometry," in *INCONIE : 4th International Conference on Islam and Education*, 2026, pp. 2464–2476.

[4] F. L. Harahap, R. Andrianto, P. Panggabean, P. Hanafia, Panusunan, and M. Garang, "Pengembangan Aplikasi Kalkulator Multifungsi Menggunakan Flutter Framework," *J. Penelit. Teknol. Inf. dan Sains*, vol. 1, no. 3, pp. 76–84, 2023.

[5] P. A. Udil, "Pengembangan Bahan Ajar Analisis Kompleks Berbasis E-Learning," *Haumeni J. Educ.*, vol. 2, no. 1, pp. 154–166, 2022.

[6] R. Akbar, B. Pramono, and R. A. Saputra, "Implementasi Algoritma Simon Pada Aplikasi Kamus Perubahan Fi ' il (Kata Kerja Bahasa Arab) Berbasis Android," *ULTIMATICS*, vol. 13, no. 1, pp. 12–18, 2021.

[7] N. C. Putra, Hartono, and U. D. Susiaty, "Kalkulator Berkarakter Berbasis Android terhadap Kemampuan Pemahaman Konsep pada Materi Barisan dan Deret Aritmatika Siswa Sekolah Menengah Atas," *Algoritm. J. Mat. Ilmu Pengetah. Alam, Kebumian dan Angkasa*, vol. 2, no. 5, pp. 126–138, 2024.

[8] S. Asyari, Sabri, and Djadir, "Pembelajaran Matematika Sekolah dengan Menggunakan Kalkulator Casio fx-991EX ClassWiz," *SMART J. Pengabdi. Kpd. Masy.*, vol. 1, no. 1, pp. 56–80, 2021.

[9] Kurniawati and A. I. Pawelloi, "Aplikasi Kalkulator Menggunakan Suara Berbasis Android," *J. Sintaks Logika(JSilog)*, vol. 3, no. 3, pp. 24–28, 2023.

[10] N. M. Damayanti, F. Sarnita, and A. R. Hakim, "Penggunaan Kalkulator Ai Sebagai Media Interaktif Dalam Membentuk Pemahaman Konsep Dan Melatih Kemampuan Berpikir Kreatif Siswa Tunanetra," *J. PIPA Pendidik. Ilmu Pengetah. Alam*, vol. 05, no. 02, pp. 64–72, 2024.

[11] A. A. Nafisah and A. A. Mustofa, "Pemanfaatan Website Matrix Calculator untuk Menunjang Pembelajaran Matriks pada Mahasiswa Matematika," *Pros. Forum Mat.*, vol. 1, no. 1, pp. 1–10, 2024.

[12] M. S. Alan, R. Muhaimin, and H. Fatoni, *Menyelesaikan Permasalahan Matematika, Sains dan Keislaman dengan Menggunakan WolframAlpha*, Agustus 20. Mataram: Sanabil.web.id, 2021.

[13] Interactive Mathematics, https://www.intmath.com/complex-numbers/convert-polar-rectangular-interactive.php