

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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REPORT ON MICRO PROJECT

“ DIGITAL ELECTRONICS CIRCUITS AND VERILOG ”

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING.

“ DIGITAL CALCULATOR USING ARDUINO UNO.”

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ABSTRACT: DIGITAL CALCULATOR USING ARDUINO UNO.

A digital calculator is a compact and versatile electronic device engineered to perform a wide array of mathematical operations, ranging from basic arithmetic to advanced scientific and financial calculations. By leveraging digital logic and computational algorithms, calculators convert user inputs into binary data, process these calculations through a microprocessor, and display the results in real-time on an LCD or LED interface. The simplicity and speed of calculators have made them indispensable tools in education, science, engineering, and business.

Modern digital calculators are characterized by their ability to handle complex computations with high accuracy, portability, and energy efficiency. They range from basic models designed for everyday arithmetic to advanced devices capable of solving trigonometric equations, graphing functions, and programming custom routines. With advancements in technology, contemporary calculators now integrate features such as connectivity options (USB, Bluetooth), programmability, graphical displays, and artificial intelligence for enhanced functionality. These features allow calculators to cater to specialized fields such as engineering design, statistical analysis, and financial modelling.

The evolution of digital calculators, from early mechanical devices to modern smart calculators, reflects significant technological progress. Their ongoing development promises further integration with cloud computing, machine learning, and mobile devices, making them even more powerful tools for problem-solving and data analysis.

This paper aims to explore the architecture, functionality, applications, and technological advancements of digital calculators, emphasizing their pivotal role in simplifying and accelerating computational tasks across various industries.

INTRODUCTION:

Digital calculators are indispensable tools in modern society, simplifying and automating mathematical tasks for users across a wide range of applications. Their invention revolutionized computation, making it accessible, efficient, and portable. From simple arithmetic to advanced operations such as solving equations, graphing functions, and statistical analysis, digital calculators have become essential devices in education, engineering, business, and everyday life.

A digital calculator functions by converting user input into machine-readable binary code, processing it through a microprocessor, and displaying the result in a user-friendly format. This process eliminates the possibility of manual calculation errors while ensuring high-speed results. Over time, advancements in semiconductor technology and computational algorithms have significantly enhanced the functionality and versatility of digital calculators.

The evolution of calculators can be traced back to early mechanical devices like the abacus and slide rule, which required manual operation. With the advent of electronic components, the first calculators transitioned into basic digital models capable of performing simple arithmetic. Today, calculators have advanced to include scientific, financial, and graphing capabilities, and many are equipped with connectivity features such as USB ports, Bluetooth, and cloud integration.

This paper discusses the working principles, architecture, and types of digital calculators, along with their applications and recent technological advancements. By understanding the fundamental design and evolution of calculators, we can appreciate their role in advancing productivity and problem-solving across various domains.

The rapid advancements in microelectronics and software development have allowed calculators to evolve beyond their initial purpose of simple computation. Modern calculators are highly sophisticated tools capable of handling specialized tasks such as symbolic algebra, statistical modelling, and programmable routines. These features cater to the needs of professionals, students, and researchers, making digital calculators indispensable in technical fields like engineering, science, and finance.

The accessibility of digital calculators has also had a profound impact on education, helping students grasp complex mathematical concepts more easily and enabling educators to focus on problem-solving and critical thinking rather than manual calculations. In business and financial sectors, calculators streamline tasks such as interest rate computations, budgeting, and forecasting, saving time and reducing the risk of errors.

The technological progression of calculators continues, with trends such as artificial intelligence (AI) integration, cloud-based computation, and hybrid devices combining calculator functionality with other digital tools like smartphones and tablets. These innovations ensure the continued relevance of calculators in an increasingly digital world.

MOTIVATION:

The development and continuous evolution of digital calculators are driven by the need for efficient, accurate, and portable tools to perform mathematical computations. From early mechanical devices to advanced electronic systems, calculators have addressed the growing demand for speed and precision in a world increasingly reliant on data-driven decision-making and problem-solving.

In academic settings, students and educators require tools that not only simplify complex calculations but also aid in understanding advanced mathematical concepts. Digital calculators provide an accessible and reliable solution, enabling learners to focus on problem-solving and analysis rather than manual computations. Similarly, professionals in engineering, science, and finance need calculators capable of handling intricate computations quickly and with minimal error, thereby increasing productivity and reducing the risk of costly mistakes.

OBJECTIVE OF THE PROJECT:

- 1. Design and Functionality:** Develop a digital calculator capable of performing basic arithmetic operations and advanced mathematical functions like trigonometry and logarithms with accuracy and efficiency.
- 2. User Interface and Experience:** Create an intuitive and user-friendly interface for seamless operation, ensuring clear display of results and easy input methods (keypad or touchscreen).
- 3. Optimization and Portability:** Ensure the calculator is energy-efficient, portable, and optimized for faster processing and minimal power consumption.
- 4. Advanced Features and Applications:** Explore integration of advanced features such as programmability, data storage, connectivity, and potential AI functionalities for specialized applications in education, engineering, and business.
- 5. Ensure Accuracy and Reliability :**To ensure that the calculator provides precise results for all mathematical operations and handles edge cases or errors (such as division by zero) gracefully, displaying appropriate error messages for invalid inputs.
- 6. Cater to Educational and Professional Use :**To create a versatile calculator that can be used effectively in educational settings for learning and teaching mathematics, as well as in professional fields such as engineering, science, and finance for more complex calculations.

By achieving these objectives, the project will deliver a high-quality, user-centric digital calculator that is versatile, easy to use, and capable of performing a broad spectrum of mathematical tasks. The final product will cater to various users, from students and educators to professionals in fields like engineering, finance, and research, ensuring its practicality and long-term usefulness in both academic and professional settings.

SYSTEM OVERVIEW:

The digital calculator system is a compact electronic device designed to perform a variety of mathematical operations with speed, accuracy, and ease of use. It utilizes a combination of hardware and software components to handle user inputs, process calculations, and display the results. The system operates through a user-friendly interface, processing both simple arithmetic and advanced mathematical functions.

MATERIALS REQUIRED:

1. Arduino Uno
2. 16×2 LCD Display
3. I2C module
4. 4×4 Keypad
5. 9V Battery
6. Jumper wires

CIRCUIT DIAGRAM:

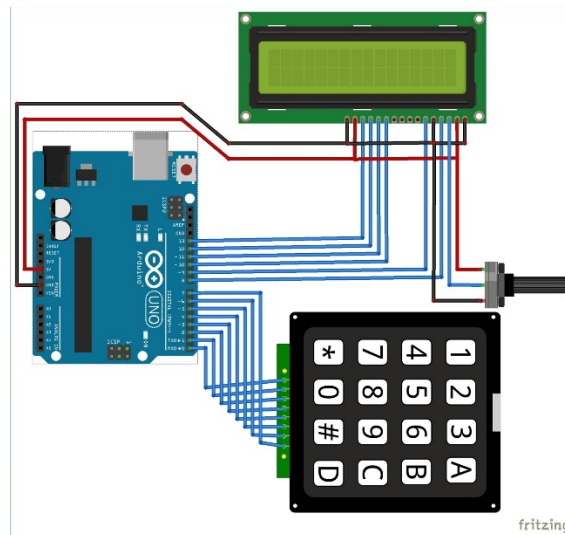


Fig:1.1

Programming is always fun and Arduino is a wonderful platform if you are just getting started with Embedded programming. In this tutorial we will **build our own calculator with Arduino**. The values can be sent in through a **keypad (4×4 keypad)** and result can be viewed on a **LCD screen (16×2 Dot-matrix)**. This calculator could perform simple operations like Addition, Subtraction, Multiplication and Division with whole numbers. But once you understand the concept you can implement even scientific functions with Arduino's built in functions.

At the end of this project you will know how to use a [16x2 LCD](#) and Keypad with Arduino and also how easy it is to program for them using the readily available libraries. You will also understand how to program your Arduino for accomplishing a particular task.

The complete circuit diagram of this **Arduino Calculator Project** is given above. The +5V and ground connection shown in the circuit diagram can be obtained from the 5V and ground pin of the Arduino. The Arduino itself can be powered from your laptop or through the DC jack using a 12V adapter or 9V battery.

We are operating the [LCD in 4-bit mode with Arduino](#) so only the last four data bits of the LCD is connected to Arduino. The Keyboard will have 8 output pins which have to be connected from pin 0 to pin 7 as shown above. You can use the following connection table to verify your connection with Arduino, you can also check [4x4 Keypad interfacing with Arduino](#).

Working of Arduino Calculator:

Make the connections as per circuit diagram and upload the code below. If it shows error make sure you have added the library as per the instruction given above. You can also try the simulation to check if the problem is with your hardware. If everything is done as it's supposed to be, then your hardware will look something like this below with the LCD displaying this.

BLOCK DIAGRAM:

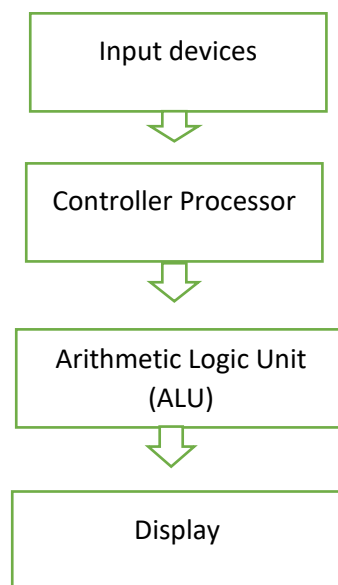


Fig:1.2

Explanation of Components:

1. Input Devices:

- These are the keys on the calculator used to input numbers and operations (e.g., digits, addition, subtraction).
- Includes keypad, switches, or touch input.

2. Controller/Processor:

- Acts as the brain of the calculator.
- Decodes the input commands and controls the flow of data between other blocks.

3. Arithmetic Logic Unit (ALU):

- Performs the core mathematical operations such as addition, subtraction, multiplication, and division.
- May also handle logical operations if the calculator supports advanced functionality.

4. Display/Output:

- Outputs the result of calculations.

- Includes LCD or LED screens for numeric and symbolic display.
- 5. **Power Supply:**
 - Provides power to all the components, typically through 9V batteries or solar cells.

SYSTEM WORKFLOW:

1. User Input:

The user enters numbers and operators using the input interface (keypad or touchscreen). This input is translated into binary data that the microprocessor can understand.

2. Data Processing:

The microprocessor processes the input using internal algorithms to perform the requested operation (addition, subtraction, multiplication, etc.). For advanced functions like trigonometric or logarithmic calculations, the microprocessor uses mathematical algorithms stored in memory.

3. Output:

After processing, the result is displayed on the screen for the user to view. If the operation requires more processing or is part of a sequence, the calculator will continue to process until a final result is displayed.

4. Error Handling:

If an invalid input or calculation occurs (e.g., division by zero), the calculator provides an error message or displays an error code on the screen, prompting the user to correct the input.

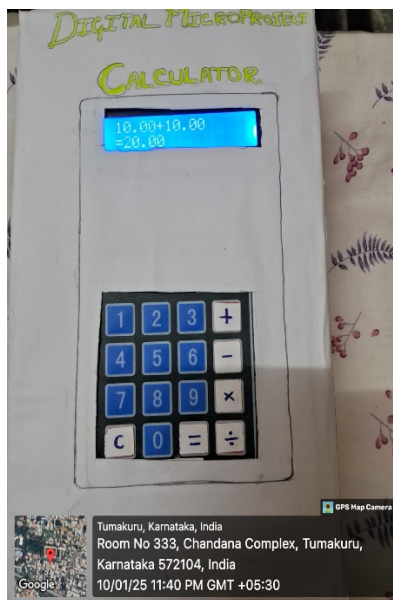
SYSTEM SOFTWARE:

Arduino IDE

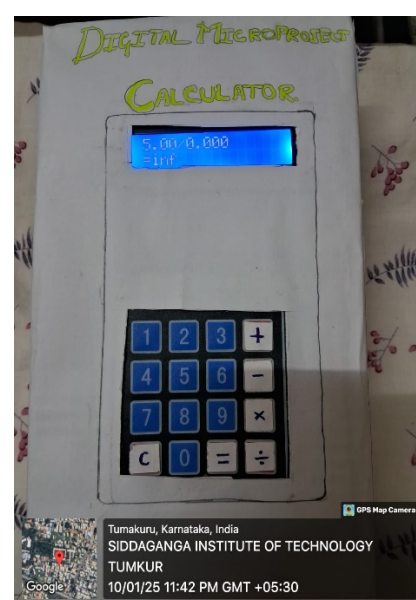
The Arduino Integrated Development Environment (IDE) is a cross-platform application that facilitates writing, compiling, and uploading code to Arduino-compatible boards. It features a simple, user-friendly interface with built-in support for various programming languages, primarily C and C++. The IDE includes a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It also comes with a serial monitor, allowing for real-time communication with the Arduino board. The Arduino IDE facilitates the implementation of the ESP32 camera web server interface through a structured process. First, install the IDE and configure it to support the ESP32 by adding the appropriate board manager URL and selecting the correct ESP32 board. Open the sketch that contains the index.html and style.css files, often embedded in the firmware using PROGMEM for storage in the ESP32's memory. Modify these files within the sketch to customize the interface. Ensure all required libraries, such as espCAMerAh and WiFiH, are installed via the Library Manager. Once modifications are complete, compile the sketch using the Verify button to check for errors and ensure proper formatting. After successful compilation, connect the ESP32 to your computer and select the correct port in the IDE. Use the Upload button to flash the updated firmware to the ESP32. Finally, access the ESP32's web server through its local IP address to verify and test the updated interface.

RESULT:

(i)



(ii)



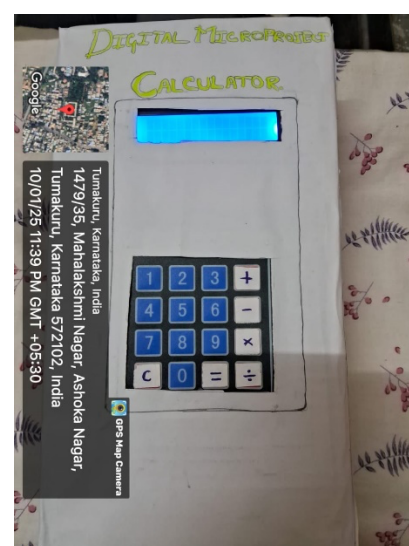
(iii)



(iv)



(v)



(vi)

Conclusion: Digital Calculator Using Arduino Uno

The implementation of a digital calculator using Arduino Uno demonstrates the practical application of microcontroller technology for basic computational tasks. This project successfully combines hardware and software to perform arithmetic operations (addition, subtraction, multiplication, and division) with user inputs through a keypad and output displayed on an LCD screen.

Final thought:

The digital calculator project highlights the versatility of Arduino Uno in educational and practical applications, proving its capability to support beginner-level to intermediate projects in embedded systems and electronics. It also serves as a stepping stone for students to explore more complex systems and IoT-based applications.