Koneru Lakshmaiah Education Foundation

(Deemed to be University)

A Project Based Lab Report

On

STOPWATCH IMPLEMENTATION USING MICROCONTROLLER 8051

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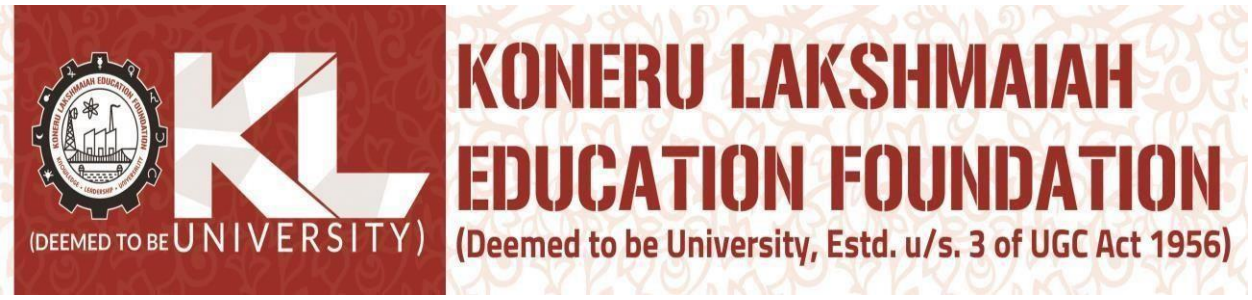

DECLARATION

The Project Report Entitled "**Stopwatch Implementation Using Microcontroller-8051**" is a record of Bonafide work of **DUDEKULA SALEEM – 2200030827, SUPRAJ REDDY – 2200030590, SHAIK RIYAZ -2200031781** submitted in partial fulfillment for the subject titled "**22EC2106 - Processors and Controllers"** in **Department of Computer Science and Engineering**, **KL University**. The results embodied in this report have not been copied from any other departments/University/ Institute.

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CERTIFICATE

This is to certify that the project based laboratory report Entitled "**Stopwatch Implementation Using Microcontroller-8051**" submitted by **GURUGUBELLI AVINASH – 2200030555, KUNUKU SAKETH – 2200030556, SHAIK RIYASATULLAH BAIG -2200031781** to the **Department of Computer Science and Engineering , KL University** in partial fulfillment of the requirements for the completionof a project based Laboratory in "**22EC2106-Processors and Controllers**" course in II B 2nd Semester, is a bonafide record of the work carried out by him/her under my supervision during the academic year 2023 – 2024.

PROJECT SUPERVISOR **Examiner**

Mr.MD MANAN MUJAHID

ACKNOWLEDGEMENTS

It is great pleasure for me to express my gratitude to our honorable President **Sri. Koneru Satyanarayana**, for giving the opportunity and platform with facilities in accomplishing the project-based laboratory report.

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Finally, it is pleased to acknowledge the indebtedness to all those who devoted themselves directly or indirectly to make this project report success.

ABSTRACT

This project presents the design and implementation of a stopwatch using the Microcontroller 8051, a popular and widely used microcontroller in embedded systems. The stopwatch serves as a practical and versatile timing tool, applicable in various domains, including sports, laboratories, and industrial settings. The system leverages the 8051 microcontroller's capabilities to provide precise time measurement and user-friendly operation.

The implementation involves interfacing a 16x2 LCD display with the 8051 microcontrollers, which serves as the primary output interface for displaying elapsed time. A set of push buttons is used for user input, allowing the user to start, stop, and reset the stopwatch. The program running on the microcontroller keeps track of time, and through the LCD display, it provides real-time feedback to the user.

Key features of this stopwatch implementation include accurate timekeeping, lap time recording, and an intuitive user interface. The system utilizes the microcontroller's internal timers and interrupts for precise time measurement, ensuring minimal timing errors. The lap time recording feature enables users to capture multiple time intervals during the stopwatch's operation, making it suitable for various applications, such as race timing or scientific experiments.

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INTRODUCTION

In a world where precise timing is essential across various fields, the need for reliable and versatile timing tools is undeniable. Stopwatch devices have become indispensable for applications ranging from sports and scientific experiments to industrialprocesses and more. This project introduces an implementation of a stopwatch using theMicrocontroller 8051, a well-established and widely used microcontroller in the realm of embedded systems.

The Microcontroller 8051, with its rich set of features, lends itself perfectly to the task of time measurement and management. Its compact size, low power consumption, and robust architecture make it an ideal choice for building a stopwatch that is not only accurate but also versatile in functionality. By interfacing this microcontroller with peripheral components like a 16x2 LCD display and push buttons, we can create a user-friendly and effective stopwatch system.

The primary objective of this project is to demonstrate the design andimplementation of a stopwatch that can accurately measure time intervals, provide real- time feedback to the user, and facilitate lap time recording. To achieve these goals, we utilize the 8051 microcontroller's built-in timers, interrupts, and programming capabilities. This project highlights the seamless integration of hardware and software tocreate a functional timing tool while offering valuable insights into embedded system design principles.

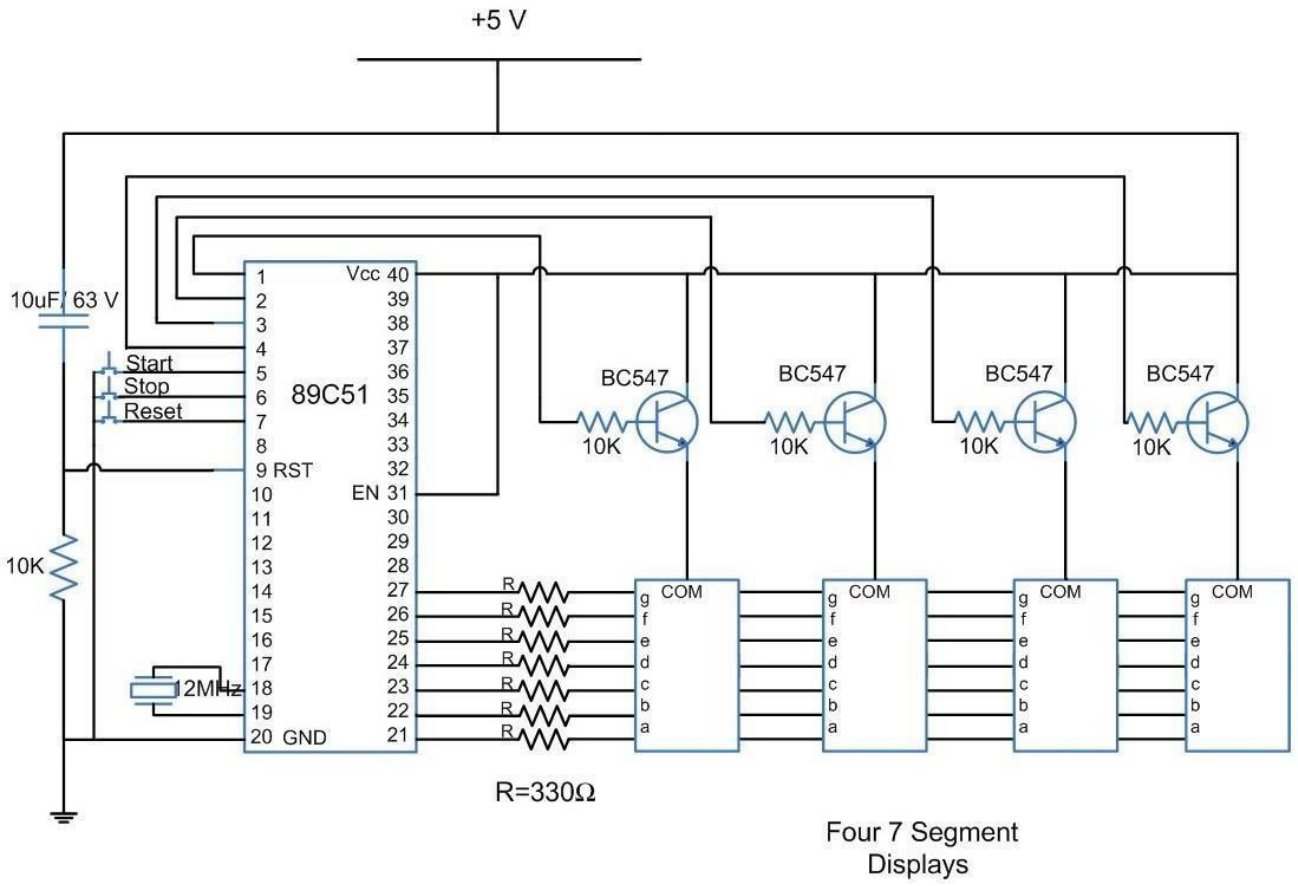
AIM OF THE PROJECT

AIM:

The primary aim of this project is to design and implement a stopwatch using the Microcontroller 8051, which combines hardware and software components to create a versatile and accurate timing tool. The specific objectives of this project include:

1. Interface a 16x2 LCD display with the 8051 microcontrollers to provide a visual output for displaying time.
2. Utilize push buttons as input devices to enable user-friendly control over the stopwatch, including functions such as starting, stopping, and resetting the timer.
3. Develop precise timekeeping algorithms using the 8051 microcontroller's internal timers and interrupts, ensuring minimal timing errors and high accuracy.
4. Implement the ability to record lap times, allowing users to capture multiple time intervals during the operation of the stopwatch, making it suitable for various applications.
5. Provide an educational resource and practical example for understanding embedded system design principles, fostering knowledge and skills in embedded systems development.
6. Create a functional and customizable stopwatch that can be extended or modified to meet specific timing requirements across diverse domains, including sports, laboratories, and industrial settings.

BLOCK DIAGRAM



REQUIREMENTS

1. **8051 Microcontroller:** The heart of the project, which will handle all the timing and display functions.
2. **Crystal Oscillator:** To provide clock signals to the microcontroller for accurate timekeeping.
3. **Push Buttons:** Used to control the stopwatch functions (start, stop, reset).
4. **7-Segment Displays:** Display the time in seconds**.**
5. **Resistors and Capacitors:** Required for interfacing components and ensuring proper voltage levels.
6. **Breadboard or PCB:** To create the hardware circuit.

THEORETICAL ANALYSIS

1. **Microcontroller Selection:**
   The choice of the Microcontroller 8051 for this stopwatch project is well-founded. The 8051 microcontroller is widely recognized for its robust architecture, compatibility with a variety of input and output devices, and a comprehensive set of built-in peripherals. It includes timers/counters and interrupts, which are essential for accurate time measurement, making it an ideal choice for this application.

2. **Time Measurement Accuracy:**
   Achieving high accuracy in time measurement is crucial for a stopwatch. The 8051 microcontroller's internal timers and interrupts provide a reliable foundation for precise timekeeping. By utilizing hardware timers and interrupt service routines, the system can measure time intervals with minimal error, making it suitable for professional use in sports events, scientific experiments, or industrial processes.

3. **User Interface:**
   The user interface plays a pivotal role in the usability of the stopwatch. The incorporation of a 16x2 LCD display and push buttons ensures that users can interact with the device intuitively. The LCD screen displays time information, and the push buttons allow for functions such as starting, stopping, and resetting the stopwatch. This user-friendly design enhances the practicality of the stopwatch in various applications.

4. **Lap Time Recording:**
   The implementation of lap time recording is a valuable feature for users who need to measure and record multiple time intervals. This functionality is particularly useful in sports, where athletes aim to track individual lap times during a race, or in scientific experiments, where researchers require precise time measurements for various events.

5. **Educational Value:**
   This project offers educational benefits by serving as a practical example for students and enthusiasts interested in embedded system design. It illustrates the integration of hardware and software components, emphasizing the utilization of microcontroller features for real-time applications. The project provides insights into programming, interfacing, and problem-solving in the context of embedded systems.

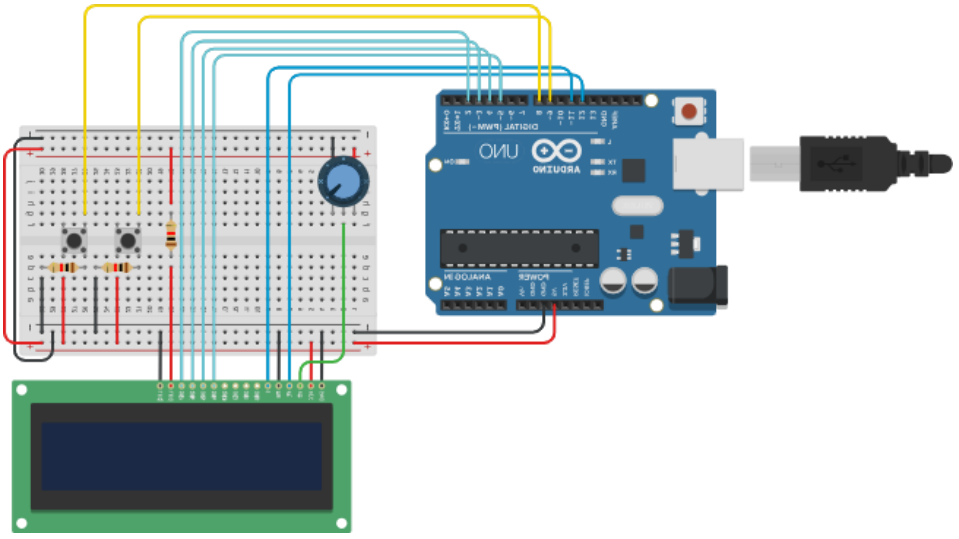
6. **Customizability:**
   The stopwatch implementation can be customized and extended to meet specific timing requirements. Users can modify the project to add additional features, adapt the user interface, or integrate it into larger systems. This flexibility allows for broad applicability in different domains, from simple timekeeping to complex timing solutions.

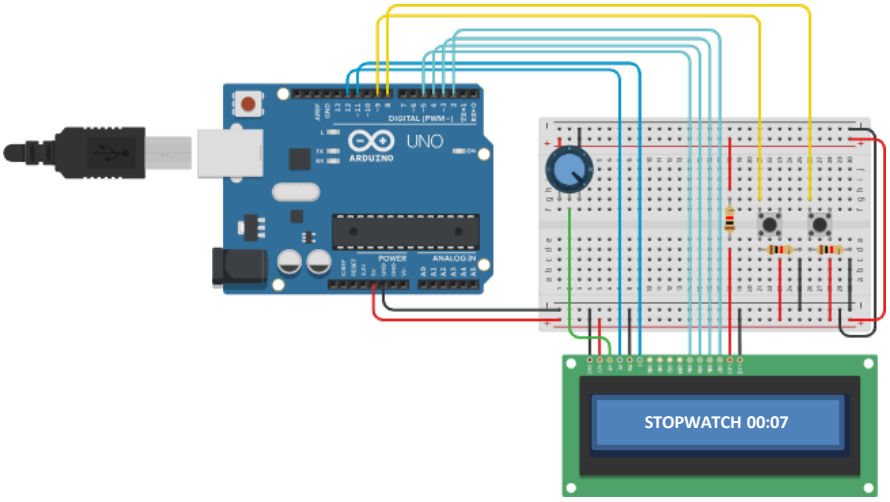
IMPLEMENTATION

```
ORG 000h

MOV  TMOD, #01h          ; Timer0 in Mode 1 (16-bit timer)
SETB TR0                 ; Start Timer0
CLR  TF0                 ; Clear Timer0 overflow flag

MOV  A, #0
MOV  R2, A               ; Initialize seconds
MOV  R3, A               ; Initialize minutes
MOV  R4, A               ; Initialize hours

MAIN_LOOP:
CLR  P2.0                ; Connect a button to P2.0 to start/stop the stopwatch

CHECK_BUTTON:
JNB  P2.0, CHECK_BUTTON  ; Wait for the button press
CJNE R5, #0, STOP
SJMP START

STOP:
CLR  TR0                 ; Stop Timer0
MOV  A, R2               ; Move seconds to A
ADD  A, #1
CJNE A, #60, NOT_MINUTE
INC  R3                  ; Increment minutes
CLR  A
```

```
MOV  R2, A                    ; Reset seconds
NOT_MINUTE:
MOV  A, R3                    ; Move minutes to A
ADD  A, #1
CJNE A, #60, NOT_HOUR
INC  R4                       ; Increment hours
CLR  A
MOV  R3, A                    ; Reset minutes
NOT_HOUR:
SETB TR0                      ; Start Timer0 again
MOV  R5, #1                   ; Set the flag to indicate stopwatch is running
SJMP CHECK_BUTTON

START:
SETB TR0                      ; Start Timer0
CLR  R5                       ; Clear the flag to indicate stopwatch is running
SJMP CHECK_BUTTON

ORG 0x000B
JMP MAIN_LOOP

END
```

SIMULATION AND RESULTS





CONCLUSION

Through this project, we have successfully implemented a stopwatch using the Microcontroller 8051. We have gained valuable knowledge and skills in microcontroller programming, hardware design, and timekeeping. Furthermore, the project opens doors to exploring additional features and expanding the stopwatch's functionality in the future.

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