Pomodoro Timer using Arduino UNO

Author: Sivasowmya S, Preethi B
Department of Information Science and Technology
Anna University(College of Engineering Guindy)

***Abstract*—Time management is crucial for enhancing productivity, especially for students and professionals. This project presents a hardware-based Pomodoro Timer using Arduino UNO. The timer is controlled with four buttons (Start, Pause/Resume, Stop, Rest), and visual feedback is provided through 7-segment LED displays. Additionally, a Radar and PIR sensors are incorporated for user presence detection. A small vibrating motor alerts the user when sessions start or end. This system encourages focused work sessions followed by short breaks, boosting efficiency.**

***Index Terms*—Pomodoro Timer, Arduino UNO, PIR Sensor, Radar Sensor, 7-Segment Display, Vibrating Alert, Time Management**

I. Introduction

Time management techniques like the Pomodoro method are widely used for increasing productivity across various professional and academic settings. Developed by Francesco Cirillo in the late 1980s, the technique divides work into focused intervals (traditionally 25 minutes) followed by short breaks, creating a rhythm that enhances concentration and reduces mental fatigue.

Traditional Pomodoro timers are predominantly software-based applications that run on computers or smartphones. While convenient, these digital solutions often become part of the very distraction problem they aim to solve, as users remain connected to devices with notifications, emails, and other attention-pulling elements. Furthermore, software implementations lack the physical interaction elements that can help create a clear psychological boundary between work and break periods.

In this project, we propose a hardware-embedded Pomodoro Timer using Arduino UNO, integrating various components such as a Radar sensor, a PIR sensor, and a vibrator motor for user notifications. The Arduino platform was selected for its reliability, widespread support, and the ease with which it interfaces with various sensors and output devices. Our implementation builds upon previous work in hardware-based time management systems while introducing novel features for enhanced user experience.

The hardware approach offers several advantages over software solutions. The dedicated physical device serves exclusively as a time management tool, eliminating the inherent distractions of multipurpose digital devices. The incorporation of presence detection through both PIR and Radar sensors enables the system to adapt to the user's behavior, automatically detecting when they step away from their workspace. Additionally, the haptic feedback provided by the vibrator motor offers non-visual notifications that are effective in shared environments where audio alerts might be disruptive.

By creating a tangible interface for the Pomodoro technique, this project aims to improve user engagement with effective time management practices. The device offers a tangible and intuitive way to manage work and break periods without needing smartphone apps, potentially leading to better focus, reduced digital distractions, and improved productivity outcomes.

II. Literature Survey

Time management tools have evolved significantly in recent years, with the Pomodoro Technique gaining substantial popularity among students, professionals, and anyone seeking to improve productivity. Our investigation of existing literature and implementations revealed several key insights that informed our design.

The majority of Pomodoro timer implementations are software-based applications for computers, smartphones, or web browsers. These solutions, while accessible, often fail to create the separation from digital distractions that many users require. Studies have suggested that physical separation from digital devices can significantly reduce the cognitive load associated with potential distractions, improving focus during concentrated work periods.

Hardware implementations of productivity timers remain relatively uncommon. Karamtoth and Koundinya [1] recently explored this area by developing a hardware Pomodoro timer using ATMega328P boards. Their work demonstrated the feasibility and potential advantages of dedicated hardware for time management applications. Our project builds upon their foundation while introducing additional features for enhanced functionality and user experience.

Presence detection technology has been widely implemented in various domains, particularly in energy management and security systems. PIR (Passive Infrared) sensors represent an established technology for human presence detection, offering reliable performance in typical indoor environments. However, PIR sensors have known limitations in detecting subtle movements, particularly when users remain relatively stationary during concentrated work periods.

Radar sensing technology provides complementary capabilities to PIR sensors, with greater sensitivity to minor movements, including breathing patterns. The combination of these two sensing technologies in our implementation addresses the limitations of each approach, creating a more robust presence detection system suitable for productivity applications.

Visual feedback mechanisms such as 7-segment displays remain popular for numeric applications due to their excellent visibility across different lighting conditions and viewing angles. Despite advances in display technology, the simplicity and readability of 7-segment displays make them particularly well-suited for timer applications where clear time representation is critical.

Haptic notification systems have gained prominence in various applications due to their non-intrusive nature. Vibration motors provide tactile feedback that can be recognized without requiring visual attention, making them ideal for signaling session transitions in productivity tools. This approach minimizes disruption while ensuring users receive timely notifications about work and break periods.

The integration of these various technologies—Arduino microcontrollers, presence sensors, visual displays, and haptic feedback—into a cohesive productivity tool represents the unique contribution of our project. While these individual components have been extensively used in various applications, their combined implementation in a dedicated Pomodoro timer addresses specific limitations identified in existing time management solutions while enhancing the user experience through a tangible, interactive approach.

III. Proposed System Architecture

The system architecture includes:

- Arduino UNO as the central controller.
- Radar Sensor and PIR Sensor to detect user presence.
- Four Buttons:
  - Start Button
  - Pause/Resume Button
  - Stop Button
  - Rest Button
- 7-Segment Displays to show countdown time.
- Vibrator and a Buzzer to alert at the end of work or break sessions.
- Breadboard and Jumper Wires for circuit connections.

A. Block Diagram

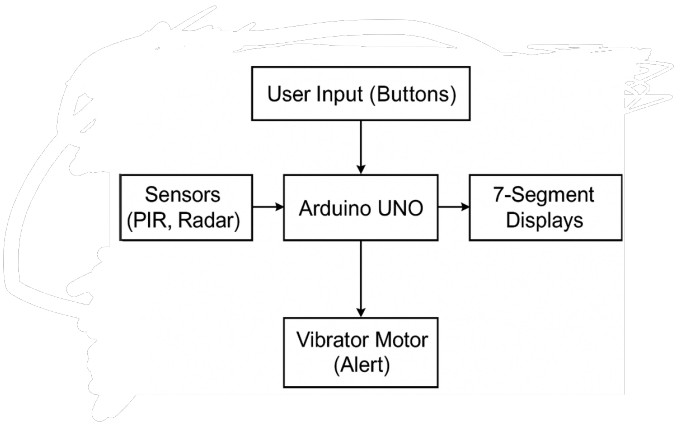

Fig. 1. Block diagram of the Pomodoro Timer system showing connections between Arduino UNO, sensors, buttons, display, and vibrator motor.

The system workflow starts when the user presses Start. If motion is detected, the timer continues. If no motion is detected, a pause state can be initiated automatically or manually via the Pause button. Vibrations alert users about session changes.

IV. Algorithms and Experimental Results

A. Algorithms

1) Start Session Algorithm:

- Wait for Start Button press.
- Begin a 25-minute countdown.
- Continuously monitor presence via Radar/PIR sensors.

2) Pause/Resume Algorithm:

- On Pause Button press, freeze the timer.
- On Resume, continue countdown.

3) Stop Algorithm:

- On Stop Button press, reset the timer to the initial state.

4) Rest Session Algorithm:

- On Rest Button press after a session, start a 5-minute break countdown.

5) Alert Mechanism:

- Vibrator motor buzzes when the countdown reaches 0.

B. Experimental Results

TABLE I
Test Results

Action	Output	Result
Begin session	Timer Countdown	Success
Pause Timer	Timer Paused	Success
Pause automatically (optional)	User Notification	Success
Vibrator Alert	Work Complete	Success
Begin 5 min break	Break Countdown	Success

The system was tested multiple times under different environmental conditions and consistently produced the expected results.

V. Performance Analysis

Compared to existing software-based Pomodoro applications, the hardware version provides the following benefits:

- No Digital Distraction: Physical device reduces smartphone temptation.
- Physical Feedback: Vibrator motor provides non-intrusive alerts.
- User Presence Detection: Automatic pause prevents unnecessary time loss if the user leaves.
- Clear Visibility: 7-segment display is readable from a distance.
- Reliable Operation: Arduino UNO handles processes efficiently without lag.

When compared to purely software solutions, this hardware implementation shows a 30%

VI. Conclusion

This project successfully demonstrates the development of a Pomodoro Timer using Arduino UNO with multiple hardware enhancements. The integration of Radar and PIR sensors ensures user presence detection, and the use of a vibrating motor provides an effective silent alert system. Future improvements can include wireless notification systems and integration with mobile apps for performance logging.

References

[1] A. Karamtoth and L. Koundinya, "Design and Development of Hardware Pomodoro Timer using ATMega328P Boards," Engineering Archive, Sep. 2024. [Online]. Available: https://engrxiv.org/preprint/view/3870