# DLD Project Report

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**Digital Stopwatch using Arduino Uno**

**Main Objective:**

The aim of this project was to make an Arduino-based stopwatch that would display the amount of time that elapses between the pressing of the start and stop buttons.

**Introduction:**

The stopwatch contains an LCD that will display the time elapsed in hours, minutes, seconds, and milliseconds. The start, stop, reset and lap buttons will be used by the user accordingly.

**Methodology:**

Different components were used to create a stopwatch. Firstly, 4 push buttons i.e., start, stop, reset, and lap and were added to the breadboard. They were used to generate the analog input via a button press and similarly to control the output of the stopwatch .A buzzer was used that would make a sound every time a button was pressed along with LEDs that would light up.Green Led was used to show that the stopwatch was running and red led was shown to display it was stopped .Hard jumper wires and resistors were then added to different areas of the breadboard. .Arduino was then connected through 5v power and ground to the positive and negative rails on the breadboard. Arduino Uno was used as the project was to make up a digital stopwatch and that means without using any timer IC and connecting to the LCD display,and it served both the purposes .The LCD, LEDs, buttons, and resisters were wired up by connecting the pins to their respective ports on the Arduino. Finally, the Arduino was then connected to a computer using the USB port. The code was then added to the appropriate software that would display the desired output on the LCD.

**The code of the Arduino run on is the following:**

#include <LiquidCrystal.h>

LiquidCrystal lcd(2, 3, 4, 5, 6, 7);

#define bt\_start A0

#define bt\_stop A1

#define bt\_reset A2

#define bt\_lap A3

#define G\_led 8

#define R\_led 9

#define buzzer 13

int hh = 0, mm = 0, ss = 0, ms = 0;

int lh = 0, lm = 0, ls = 0, lms = 0, lapnum = 0;

bool timerStart = false;

bool lapstart = false;

void setup() {

pinMode(bt\_start, INPUT\_PULLUP);

pinMode(bt\_stop, INPUT\_PULLUP);

pinMode(bt\_reset, INPUT\_PULLUP);

pinMode(bt\_lap, INPUT\_PULLUP);

pinMode(R\_led, OUTPUT);

pinMode(G\_led, OUTPUT);

pinMode(buzzer, OUTPUT);

lcd.begin(16, 2); //

lcd.clear();

lcd.setCursor (0, 0);

lcd.print(" DLD Project");

delay(1000);

lcd.setCursor (0, 1);

lcd.print(" by Talha ");

delay(1000);

lcd.setCursor(0, 2);

lcd.print(" Umer and Ismail");

delay(2000);

lcd.clear();

noInterrupts();

TCCR1A = 0;

TCCR1B = 0;

TCNT1 = 0;

OCR1A = 1999;

TCCR1B |= (1 << WGM12);

TCCR1B |= (1 << CS11);

TIMSK1 |= (1 << OCIE1A);

interrupts();

}

void loop() {

lapstart = false;

if (digitalRead (bt\_start) == 0) {

digitalWrite(buzzer, HIGH);

timerStart = true;

delay(100);

}

if (digitalRead (bt\_stop) == 0) {

digitalWrite(buzzer, HIGH);

timerStart = false;

delay(100);

}

if (digitalRead (bt\_reset) == 0) {

digitalWrite(buzzer, HIGH);

ms = 0, ss = 0, mm = 0, hh = 0;

delay(100);

lapstart = false;

lcd.clear();

}

if (digitalRead (bt\_lap) == 0) {

digitalWrite(buzzer, HIGH);

lapstart = true;

}

lcd.setCursor (2, 0);

lcd.print((hh / 10) % 10);

lcd.print(hh % 10);

lcd.print(":");

lcd.print((mm / 10) % 10);

lcd.print(mm % 10);

lcd.print(":");

lcd.print((ss / 10) % 10);

lcd.print(ss % 10);

lcd.print(":");

lcd.print((ms / 100) % 10);

lcd.print((ms / 10) % 10);

lcd.print(ms % 10);

if (timerStart == true) {

digitalWrite(G\_led, HIGH);

digitalWrite(R\_led, LOW);

} else {

digitalWrite(G\_led, LOW);

digitalWrite(R\_led, HIGH);

}

digitalWrite(buzzer, LOW);

if ((lapstart == true)) {

digitalWrite(buzzer, LOW);

lapnum = lapnum + 1;

lh = hh - lh;

lm = mm - lh;

ls = ss - ls;

lms = ms - lms;

lcd.setCursor(0, 1);

lcd.print("Lap");

lcd.setCursor(3, 1);

lcd.print(lapnum);

lcd.setCursor(5, 1);

lcd.print((lh / 10) % 10);

lcd.print((lh / 10) % 10);

lcd.print(lh % 10);

lcd.print(":");

lcd.print((lm / 10) % 10);

lcd.print((lm / 10) % 10);

lcd.print(lm % 10);

lcd.print(":");

lcd.print((ls / 10) % 10);

lcd.print(ls % 10);

lcd.print(":");

lcd.print((lms / 100) % 10);

lcd.print((lms / 10) % 10);

lcd.print(lms % 10);

}

}

ISR(TIMER1\_COMPA\_vect) {

if (timerStart == true) {

ms = ms + 1;

if (ms > 999) {

ms = 0; ss = ss + 1;

if (ss > 59) {

ss = 0;

mm = mm + 1;

}

if (mm > 59) {

mm = 0;

hh = hh + 1;

}

}

}

}

**Findings of the experiment:**

Individual components were first tested before starting the experiment and their responses were thoroughly checked. A circuit diagram was used to trace connections so that the desired output could be reached. We had to go through the circuit diagram and its implementation on the hardware level again and again to make sure that all connections were joined correctly and were matching the circuit diagram. In the end the Arduino was loaded up with the software that showed the display.

**Application:**

Stopwatches are used to track down time to complete an exercise, in sports it can be used as judging tool for competitiveness in the participants.

**Conclusion:**

This project made us familiar with different types of hardware components and their functionalities. The stopwatch is running as it was supposed and we were able to complete all the tasks aside, from the lap function, we had set our goals for. The importance of taking correct steps to reach up a working hardware solution was also learnt by this project and how to cater and handle the components ranging from the smallest (100 R resistor) to the largest (Arduino) and ensuring they all run on their expectation.