

CS324 – Graphics Coursework: Documentation

Features

The program has the following modes:

- Analog clock and date
- Digital clock and calendar
- Stopwatch

Design

What the program displays on the screen is dependent on the mode that it is in. A global variable `mode` is set to different values when the user presses a number on the keyboard. The table below indicates the different modes and the number that are to be pressed to access the mode while the program is running.

Number	Mode
1	Analog clock
2	Digital clock
3	Stopwatch
5	Help page

Analog Clock

The circle for the analogue clock was drawn using the code from `circle-points.cpp` (Lab 1). For each calculation of a vertex's coordinates, (x, y) , a point was drawn at that coordinate using `glVertex2f(x, y)`. The calculation of the circle vertices starts at three o'clock and continues in an anticlockwise direction. Therefore, the order of the numbers to be draw was changed to reflect



Figure 1- Screenshot of the analogue clock

this.

The number at the centre-right position on the clock face indicates the current day of the month, similar to many watches.

The function `draw_hands()` draws the clock hands for the analog clock based on the system time. The current time is retrieved using the `<ctime>` library [1]. The time is available as a string and includes extra information such as the date and the day of the week. The string is parsed to extract the current hour and minute in 12 hour format and this is then used to calculate the endpoint

coordinates of each hand. The calculation involves determining the correct angles from the twelve o'clock position using:

$$x' = x \cos \theta - y \sin \theta$$
$$y' = x \sin \theta + y \cos \theta$$

where (x', y') is the result of (x, y) being rotated anticlockwise through an angle of θ about the origin $(0, 0)$. There were a number of further steps given the fact that clock hands rotate clockwise and about the centre of the clock circle (as opposed to the origin of the coordinate system).

To add a texture to clock face, the function `glTexCoord2f()` was called after each vertex of the circle with help from [2] as to how to get the texture to appear appropriately. The loading of the png files was done as in `texture.cpp` (Lab 7).

Stopwatch

Stopwatch – The stopwatch works by calculating and displaying the *difference* between the time since epoch when the stopwatch was started and the current time. The current time (in seconds and nanoseconds) since epoch is retrieved through `clock_gettime()` [3]. This is used to then display the milliseconds, seconds, minutes and hours that have elapsed. When the stopwatch is paused, the last stored difference is displayed and the length of time the stopwatch is paused for is recorded. When the stopwatch resumes, it calculates the difference between the current time and the start time, but also subtracts the total pause time.



Figure 2- Screenshot of the stopwatch.

Calendar

The calendar makes use of the information available in the time structure (`struct tm`) to display the calendar for a particular month. The user can change the month that is displayed by using the left and right arrow keys. The current date is highlighted in red.

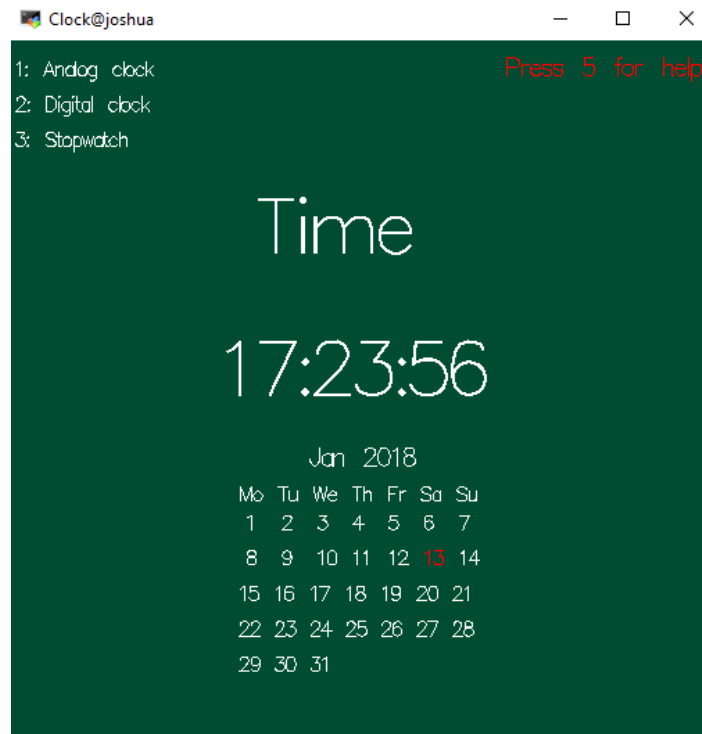


Figure 3 - Screenshot of digital clock and calendar.

OpenGL Features Used

- Texture mapping – a selection of textures can be applied to the clock face.
- `glutKeyboardFunc()` – allows the user to access the different features of the app via keyboard input.
- `glutSpecialFunc()` – allows the user to use the left and right arrow keys to change the month displayed on the calendar.
- `glutStrokeCharacter()` – is used to generate characters for text.

How to Run and Use the Program

The folder 'coursework' contains all the necessary files to run the program on the **DCS machines**.

Compilation

From this folder, run the following command to compile the program:

```
make -f Makefile.linux clock
```

Running the Program

To run then run the program, enter:

./clock

Analog Clock Options

Option	Button to press
Arabic numbering displayed on clock	a
Roman numerals displayed on clock	r
'Magical swirl' clock face texture	A
Star Wars logo clock face texture	B
Mountains clock face texture	C
Plain light blue clock face texture	D

Using the Stopwatch

Action	Button to press
Start/stop	s
Reset	r

Calendar

Action	Button to press
Go to previous month	Left arrow key
Go to next month	Right arrow key

695 words used

Bibliography

- [1] "<ctime> (time.h) - C++ Reference," cplusplus.com, [Online]. Available:
<http://www.cplusplus.com/reference/ctime/>.
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<https://stackoverflow.com/questions/8762826/texture-mapping-a-circle-made-using-gl-polygon>.
- [3] "clock_gettime(3): clock/time functions - Linux man page," Linux, [Online]. Available:
https://linux.die.net/man/3/clock_gettime.
- [4] sheep01280, "texture png by sheep01280 on DeviantArt," DeviantArt, [Online]. Available:
<https://sheep01280.deviantart.com/art/texture-png-681419346>.