Wrocław
University
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Intermediate project

Infinity mirror clock

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Field of study Control Engineering and Robotics
Speciality: Embedded robotics (AER)

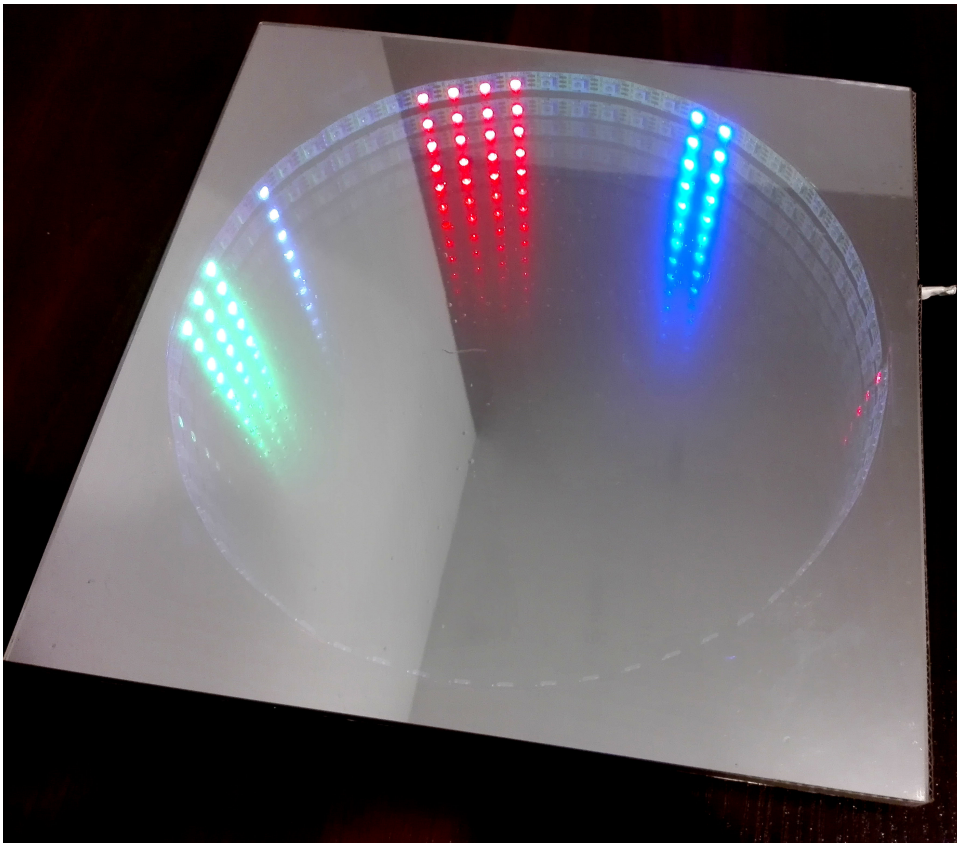

Figure. 1: Infinity Mirror Clock

1 Concept

Infinity mirror clock is a device which uses LEDs to display current time.

1.1 Displaying time

This concept uses RGB LEDs to imitate hands on the clock face. 60 LED's was needed to achieve seconds resolution and faithfully imitate the classical analog dial clock. To make distinguishing the hands of the clock easier, each of them was realized in three different colors.
Final design of described clock is presented on figure 1 and 2.

1.2 Infinity mirror effect

An infinity mirror effect is obtained using two parallel mirrors, which create series of reflections. This kind of recursion makes distance traveled by the light getting longer after each reflection that appear to recede to infinity.

2 Construction

This section contains kind of descriptive definition of done.

2.1 LED strip

Digital RGB LED strip seems to be the best option to drive such a large number of diodes going to be placed between mirrors, there fore in project was used LED strip with driver WS2812B. Control was performed using digital interface containing one digital input, which allows to omit using additional LED drivers, and significantly simplified construction.

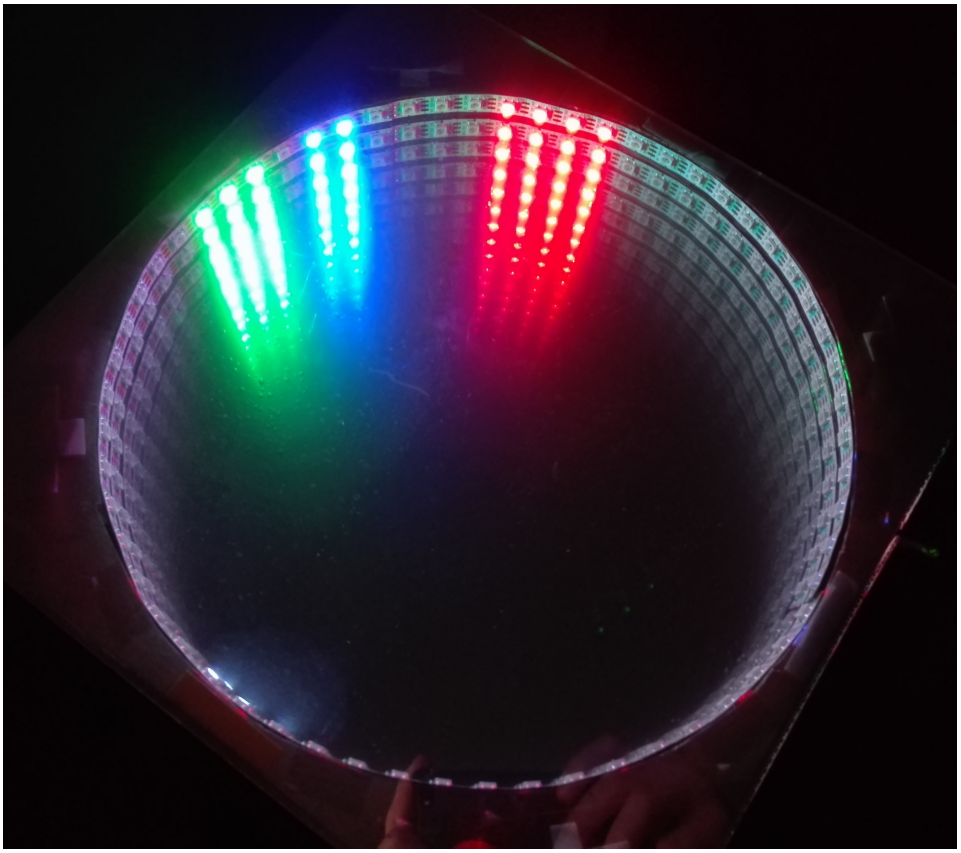

Figure. 2: Infinity Mirror Clock at darkness

WS2812B is controlled by 800kHz frequency PWM signal. It is possible to set the color of each LED's red, green and blue component with 8-bit PWM precision, which in total gives up to 24-bit color per pixel. An example of such a LED strip is presented on figure 3.

2.2 Mirrors

To obtain 3D illusion mirror light effect visible outside of system, there was used two mirrors, where one of them is a simple mirror, and the second one is semi-transparent (aka one-way) mirror. Mirrors was obtained using semi transparent mirror film glued on the Plexiglas, presented on figure 4.

2.3 Controller

As the controller was used Discovery kit with STM32F429ZI MCU, containing also 2.4" resistive touchscreen TFT LCD.

2.4 Power supply

Mentioned LED strip consumes a lot of current, therefore as an additional high-current power supply was used 5V and 2A charger with USB socket.

3 Controlling

Software part of DoD, containing "must do" and "hope to do" goals.

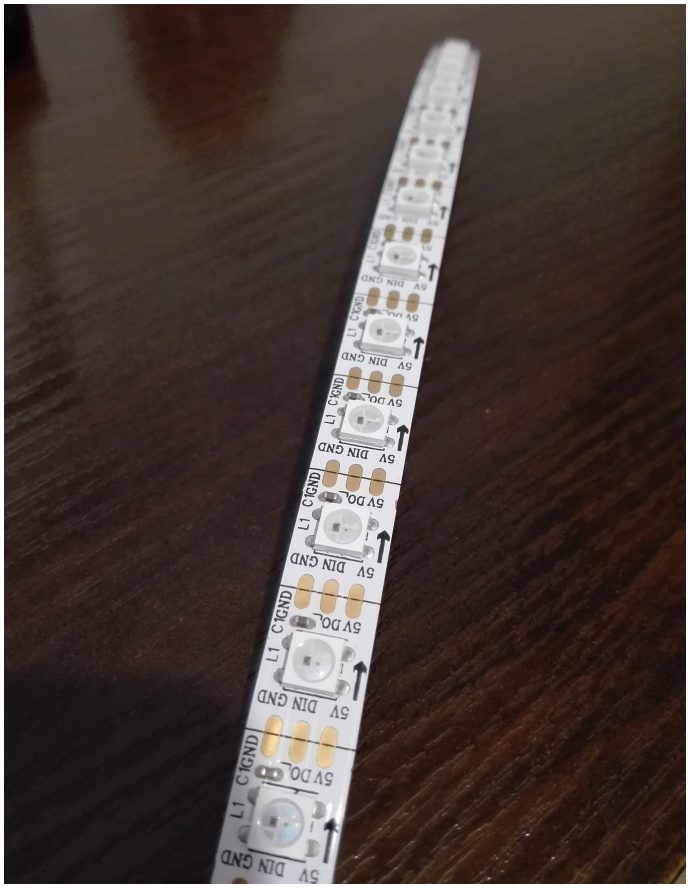

Figure. 3: Digital RGB LED strip

Figure. 4: Semi transparent mirror film

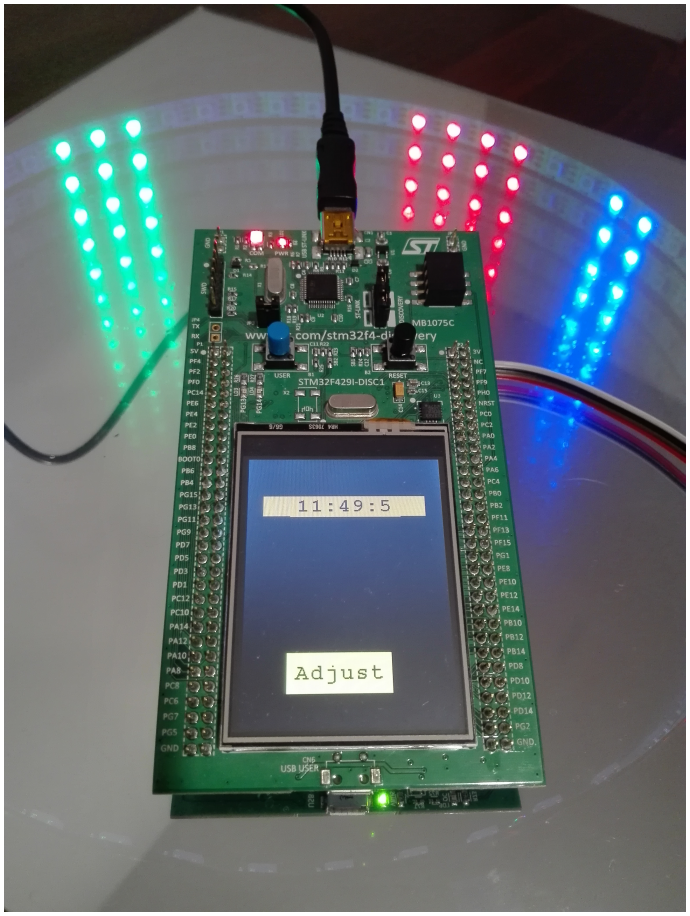

Figure. 5: GUI: Main view

3.1 Discovery control

Main control was done using touchscreen and simple GUI showed on figures 5 and 6.

Functions:

- time adjustment,
- color pallet adjustment,
- brightness control.

3.2 Android control (optional, not realized)

An additional option is control using an application on Android device connected to clock via Bluetooth module HC-06.

Exemplary functions:

- time adjustment,
- time synchronization with Android driven device,
- setting an light alarm clock,
- color pallet adjustment,
- brightness control.

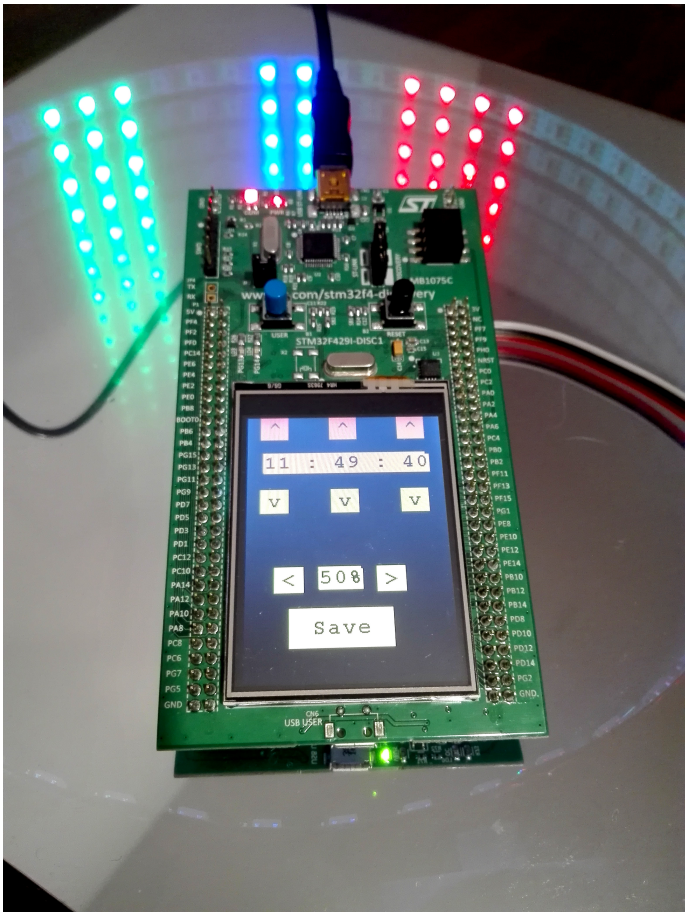

Figure. 6: GUI: Adjust view

4 Tools

List of software tools which was useful during implementation:

1. Git
2. CubeMX
3. Clion
4. GCC
5. Android studio
6. Android SDK
7. SOLIDWORKS

List of software tools which was useful during documentation creation:

1. Texmaker
2. Draw.io / StarUML
3. Adobe Illustrator

5 Resources

List of internet materials which was useful:

- Datasheets of used electronic components (e.g. LED strip, Discovery kit and Bluetooth module).
- Descriptions and tutorials of:
  - HAL's library usage,
  - C/C++ programming language functions,
  - Android library usage,
  - Java programming language functions.

Sources

WS2812B driver datasheet
Infinity mirror (Wikipedia article)
Discovery kit with STM32F429ZI MCU User manual
STM32F427xx STM32F429xx datasheet
LCD controller ILI9341 datasheet