Project Documentation

A Talking Clock created by Alice Vanni, Amber Lankheet, Brandi Hongell, Jingxuan Yue, and Wenjun Meng

Introduction

Project Name

Multilingual Talking Clock

Project Description

This is a multilingual talking clock developed for a combined assignment in the Programming and Introduction to Voice Technology courses as a part of the MSc Voice Technology program at Rijksuniversiteit Groningen - Campus Fryslân. The clock speaks the time aloud in 6 languages: Dutch, American English, Italian, Mandarin Chinese, German, and Latin. The German and Latin voices are synthesized voices, and the remaining voices are spoken by native speakers. Each language is spoken in its own respective linguistic rules for telling time.

Installation

Requirements

Installation of Python 3.6 is minimally required, however, installation of Python 3.11 is recommended. Python can be downloaded from the following link:
https://www.python.org/downloads/

A stable internet connection is required to run the program, as the program uses an API call to display weather information.

Installation Instructions

1. Click on the green code button at the top of the repository, then click Download ZIP.
2. Extract the ZIP to the location where you want to install it on your computer.
3. Open the terminal/command prompt and navigate to the file path of the extracted ZIP.
4. Run `pip install -r requirements.txt` to install the dependencies required.

User Manual for GUI

Initial View
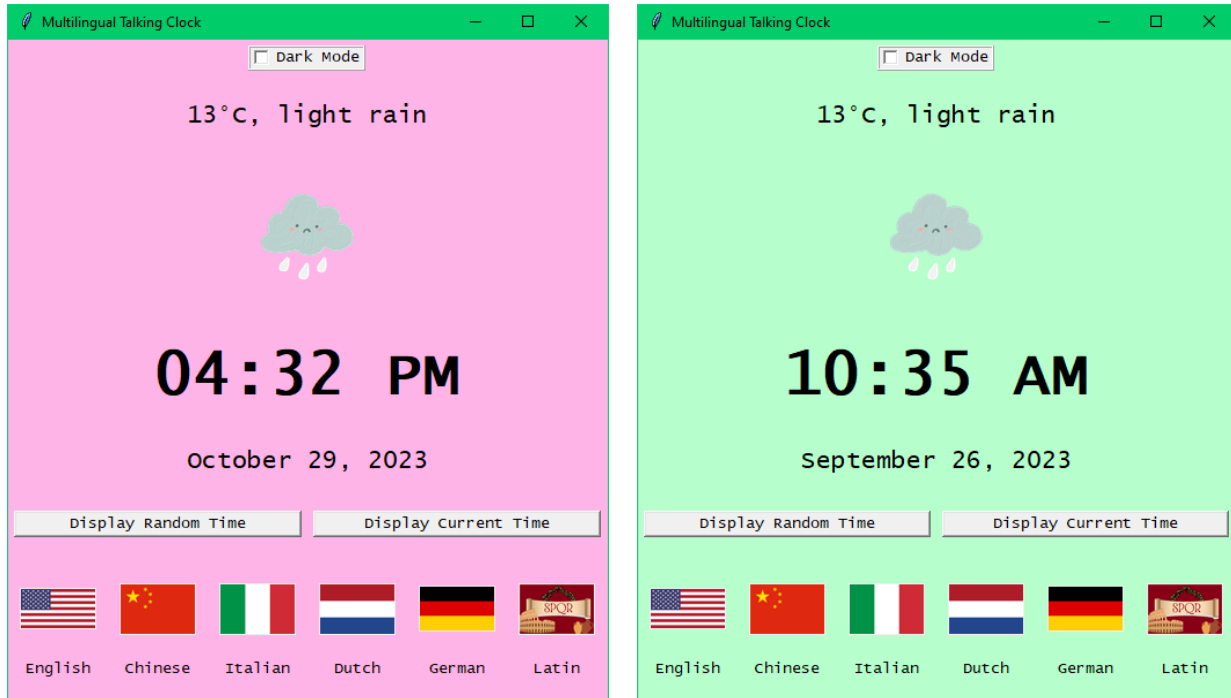
Features

The dashboard displays the following information/features:
- Dark Mode toggle
- Color-changing background (dependent on time)
- Weather Information in Leeuwarden
    - Temperature
    - Description
    - Icon
- Current Time (Determined by system settings)
- Current Date (Determined by system settings)
- Display Random Time Button
- Display Current Time Button
- Language Buttons to speak Current Time
    - English
    - Chinese
    - Italian
    - Dutch
    - German
    - Latin

Background Color

The background color is a computed gradient on a 12-hour cycle. Each hour is assigned a color, and each minute within the hour will adjust the color on a gradient towards the next hour's color.

Dark Mode
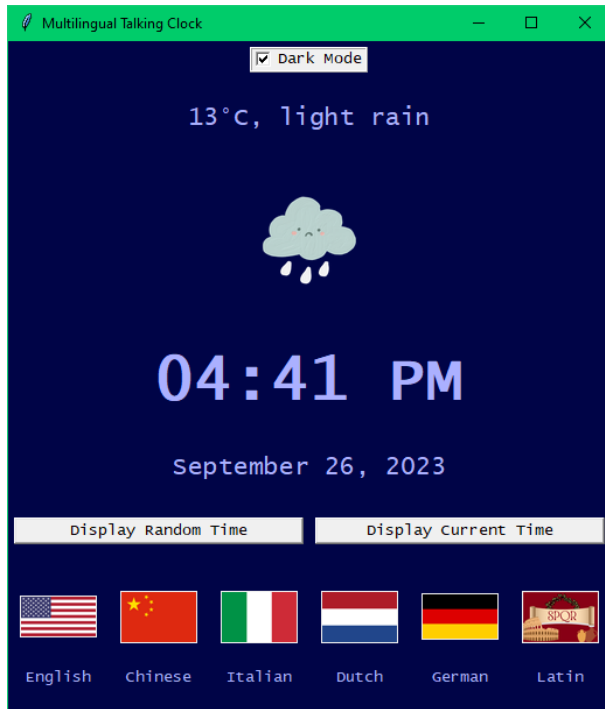
Use the **Dark Mode** toggle at the top of the GUI to enable dark mode. Dark Mode is enabled when the checkmark is visible.

Dark Mode is only available when viewing the current time. It is not available when displaying a random time, and thus, the toggle will disappear when doing so.

To disable Dark Mode, simply uncheck the toggle, and the screen will return to its assigned color value.

Weather

The weather information is displayed via the OpenWeatherMap API. The API displays the current temperature (in °C) and a brief weather condition description for Leeuwarden, NL. Additionally, it displays a corresponding icon to represent the weather description.

Weather data is updated every 10 minutes.

Time and Date

The current time and date are displayed by capturing the system time and date of the user's computer. The current time updates automatically, every 30 seconds.

Display Random Time
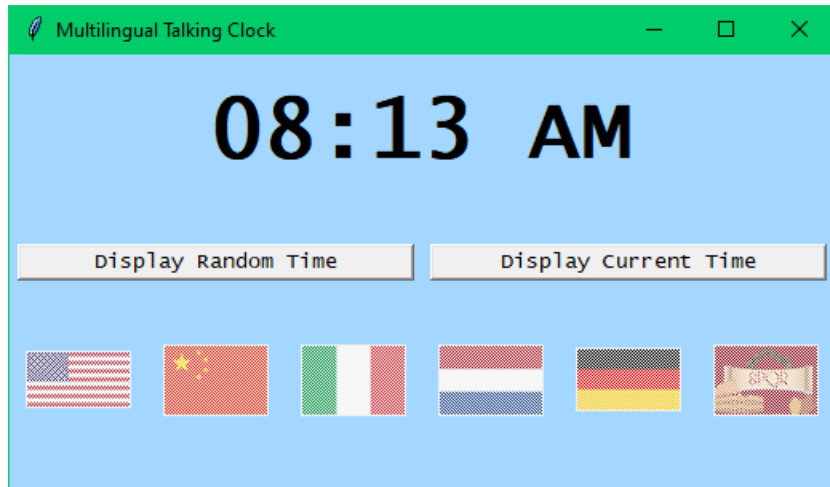
Clicking the **Display Random Time** button causes the GUI to display a randomly chosen time and correspondingly changes the background color.

Display Random Time only has effects on the GUI, and therefore the language buttons are disabled. Dark mode, date, and the weather functions are also disabled.

Display Current Time

Clicking **Display Current Time** returns the GUI to its state prior to beginning the random time sequence. This re-enables dark mode, date, weather functions, and language buttons.

Language Buttons

The language buttons are the core of the Multilingual Talking Clock program. The languages supported by the Multilingual Talking Clock program are: English, Chinese, Italian, Dutch, German, and Latin. These buttons are used to hear the current time in each of the supported languages. To hear the current time, click the language icon of the desired language.

The English, Chinese, Italian, and Dutch voices are recorded audio from native speakers (authors of the program), and the German and Latin voices are synthesized using gTTS (Google Text-to-Speech).

Linguistic Rules for Telling Time

American English

Speaking time in American English, at its base level, is very simple and straightforward. If it is the top of the hour, one would say: "It is (hour) o'clock a.m./p.m. For example, at 5:00 p.m., the time would be read as "It is 5 o'clock p.m. When minutes are involved, the time is read as: "It is (hour) (minute) a.m./p.m. For example, 5:21 p.m. would be read as: "It is five twenty-one p.m." The only thing to note when reading minutes is that minutes 01-09 are read as "oh (minute)". For example, 5:06 p.m. would be read as "It is five oh six p.m."

There are some short form ways of telling time in American English, such as 12:00 a.m. being "midnight" and 12:00 p.m. being "noon". Additionally, Americans often use terms such as "half past", which indicates 30 minutes over the current hour. For example, 5:30 p.m. could be read as: "half past five". Similarly, Americans often use "quarter till" as a way to indicate 15 minutes until the next hour. For example, 6:45 p.m. could be read as "quarter till 7". However, the Multilingual Talking Clock application does not support these short form ways of telling time.

Chinese

The logic of telling time in Chinese usually describes the current time by hour and minute. In Chinese, the following information is usually included: The hour is usually expressed in a 12-hour format, such as "shang wu 9 dian" (9:00 am) or "xia wu 3 dian" (3:00 pm). Minutes are usually expressed in Arabic numerals, followed by "fen"(minute), e.g. "9 dian 15 fen" (9:15) or "3 dian 45 fen" (3:45). When it's on the hour, "zheng" (o'clock) will be added after the hour, e.g. "9 dian zheng" (9:00 o'clock).

Additionally, the phrase "xian zai shi" (the current time is) is used to introduce a description of the time. To distinguish AM or PM, "shang wu" (AM) and "xia wu" (PM) are used at the beginning of the time description.

Italian

The Italian language has a linguistic time system similar to English, usually telling first the hour and then the minutes, and having expressions to indicate the half and the quarters of the hours. The former is expressed through the word "mezzo" or "mezza", depending on the variety, while the latter is translated to "un quarto". Hours are usually indicated using simple numbers, except for 01:00 a.m./p.m., for which the standard form of the cardinal number "uno" is not used, but the female form "una". Additionally, the Multilingual Talking Clock does not use the number to indicate 12:00 a.m./p.m., but the more spread expressions "mezzogiorno" (midday) and "mezzanotte" (midnight).

The 12-hour format is commonly used in Italy, but in formal contexts and some regional varieties, the 24-hour format is preferred. Even when using the 12-hour format, in Italian, it is not common to refer to the time using expressions equivalent to a.m. and p.m., hence the Multilingual Talking Clock does not include these references.

Instead of using all the numbers to indicate the exact minute, the Multilingual Talking Clock opts for a simplified approach to telling time in Italian by only indicating it every five minutes. Hence, the clock will not tell the exact minutes, but the closest multiple of five. For example, if the time is 4:08 p.m. it will say "quattro e dieci" (lit. en. "ten past four"). These choices reflect the most common way of telling time in Italian, despite using numbers being perfectly acceptable in the aforementioned cases. It is worth noting that these expressions are not pan-Italian, but rather based on the Tuscan variant of Italian.

Dutch

The Dutch linguistic system for telling time anchors itself on certain points in time: the hour and the 15 minute increments (:15, :30, :45).

In Dutch, whole hours are quite similar to English; however, instead of using the word 'o'clock', "uur" is used which means 'hour'. The use of 'half past' is a bit different compared to English. The use of "half" is actually followed by the next hour. For example, half past 1 in Dutch is "half 2". 'A quarter to' and 'a quarter past' are used the same compared to English. A quarter past 1, is "kwart over 1" and a quarter to is "kwart voor".

Minutes before a round hour are used in this way: 60 is subtracted by the minutes of the current time. "Het is 8 voor 9", would be translated in English to: 'It is 8 to 9' (It is 8:52). This can also be used after a whole hour. "Het is 5 over 3" would be 'It is 5 past 3' in English.

For half hours, this system is also used, but then "half" is added (remember when using "half", the next hour is used). For example, 3:40 in Dutch would be read as: "Het is 10 over half 4". The literal translation in English would be: 'It is 10 past half past 3' (It is 3:40). The same logic is used before a half hour. For example, 1:25 in Dutch would be read as: "Het is 5 voor half 2". The literal translation in English would be: 'It is 5 to half past 1' (It is 1:25).

Generally, from minute 10 of an hour until minute 20 of an hour and minute 40 until minute 50, a rounding system is used. If it is 3:13, it would be rounded to 3:15 and 3:12 would be rounded to 3:10. There are no strict requirements for rounding time in this way, but this is the most widely accepted methodology.

German and Latin

The authors of the Multilingual Talking Clock program do not speak German or Latin. Therefore, the linguistic systems listed below pertain specifically to how the time is spoken within the program and should not necessarily be referenced as legitimate rules for speaking the time in the respective languages.

The Multilingual Talking Clock speaks time in German in the following format: "It is" + hour + "hour and" + minutes + "minutes". It translates directly in German to "Es ist" + hour + "Uhr" + minutes + "minuten.

For Latin, the translation is slightly more complex as the syntactic structure of the Latin sentence is reversed. The resulting sentence will be "Hora est" + hour (expressed using cardinal numbers) + "et" + minutes (expressed using cardinal numbers) + "minuta". The literal translation would be: "The hour is ___ and ___ minutes".

Technical Documentation

Technical Stack

- Front end: tkinter
- Back end: Python
- Database: None

Resources and Libraries

- Tkinter
- time
- datetime
- requests

- gTTS
- os
- pygame
- random

Code Comments

Many functions in the Multilingual Talking Clock are accompanied by docstrings. There are also many line-by-line descriptive comments throughout the program.

Licensing, FAIR Data Principles and GDPR Compliance

Licensing

The Multilingual Talking Clock application is licensed under the MIT License. This allows others to freely use, modify, and distribute the project.

The MIT License is a short and simple permissive license with conditions only requiring preservation of copyright and license notices. Licensed works, modifications, and larger works may be distributed under different terms and without source code.

The MIT License is chosen for its simplicity and permissiveness, promoting open-source contributions and usage.

Adherence to FAIR Data Principles

- **Findable:** The Multilingual Talking Clock is hosted as a public repository on GitHub, ensuring discoverability.
- **Accessible:** Open-source licensing ensures unrestricted access to the program.
- **Interoperable:** Code is modular and well-documented, promoting integration with other projects.
- **Reusable:** Clear documentation and licensing ensure the project can be reused and repurposed.

GDPR Compliance

gTTS (Google Text-to-Speech) Integration:

For German and Latin audio generation, gTTS is used:
- **Data Anonymity:** Personal user data is never sent to gTTS. Only generic time data is processed.
- **Transient Data:** Data sent to gTTS is not stored or logged, ensuring that once audio is generated, the text data is discarded.

Author-Generated Audio Files

For English, Chinese, Italian, and Dutch, the audio files were created by the respective authors:

Each author has explicitly signed a consent form. This ensures that they are fully aware of how their voice data will be used, stored, and potentially shared. Each author acknowledges their participation voluntarily and understands their rights concerning their audio contributions.

User Data Protection

No personal user data is processed or stored in generating or playing audio. All operations are executed without linking to specific user profiles or any identifiers, guaranteeing anonymity and privacy.

Data Minimization

Only data that is essential for the project's functionality has been collected and stored. Any non-essential data, especially personal data, is beyond the collection scope, reinforcing the commitment to minimal data exposure.

Transparency and Access

Users can easily access the detailed data handling and protection policies, ensuring they're always informed about their rights and the program's practices.

By adhering to the above protocols and integrating GDPR principles at every step, the program is not only compliant with regulations but also respects individual privacy and rights.

Technical Challenges and Future Development

The Multilingual Talking Clock, while good for its intended purpose, lends itself to many future development opportunities.

Random Time Functionality

In its current state, the random time functionality only has effects on the GUI. Ideally, the random time would be stored and able to be spoken.

User-Specific Weather Data

The current weather API has its city hard-coded as Leeuwarden, NL. Ideally, this data would be user-specific.

Additional Clock Features

The clock has a strong look and basic functionality, however it lacks additional features, such as: alarm, stopwatch, timer, etc.

Customization

Future development could support additional GUI themes beyond Dark Mode rather than the enforced gradient colors.

Additional Language Support

The clock has a strong base to support many more languages with further development.

Uniform Audio Data

The recorded audio data from the authors was taken with different devices in different environments and no effort was made to ensure uniformity across all audios. While not necessary, this effort would be a nice quality of life change to the program.

Team Organization and Contributions

Team Members

- Alice Vanni
- Amber Lankheet
- Brandi Hongell
- Jingxuan Yue
- Wenjun Meng

Alice Vanni

Alice recorded the audio files for telling time in Italian. She also wrote the code for Italian, German and Latin speaking functions, and added Docstrings to many functions. Alice also created the icons for the weather and the Latin icon using the online free tool Canva.

Alice recorded the voice-over for the video presentation with the description of the Italian and Latin telling-time mechanism.

Alice also wrote the Italian, Latin, and German sections in the README.

Amber Lankheet

Amber recorded the audio files for telling time in Dutch. She also wrote the code for the Dutch speaking function. Amber also wrote the linguistic section for Dutch in the README.

For the video presentation, Amber created a description and recorded voice-over for Dutch and English.

Brandi Hongell

Brandi recorded the audio files for telling time in American English. She also wrote the code for the English speaking function. Brandi created the GitHub repository and the directory structure for the project. She developed the GUI and the helpers and Weather files. Brandi also compiled the documentation for the project.

For the video presentation, Brandi recorded the voiceover for the GUI usage.

Jingxuan Yue

Jingxuan recorded the audio for the Mandarin telling time and modified the code for Mandarin.

For the video presentation, Jingxuan recorded the voice-over with the description of the Mandarin and German telling-time mechanism.

Wenjun Meng

Wenjun edited the Mandarin audio files, modified the code for Mandarin, and wrote the linguistic rules for Mandarin.

For the video presentation, Wenjun recorded the visuals and edited the video.