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РОЗРОБКА ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ ДЛЯ ДІАГНОСТИКИ ЕСЕНЦІАЛЬНОГО ТРЕМОРУ З ВИКОРИСТАННЯМ ДИГІТАЙЗЕРА

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SOFTWARE DEVELOPMENT FOR DIAGNOSING ESSENTIAL TREMOR USING DIGITIZER

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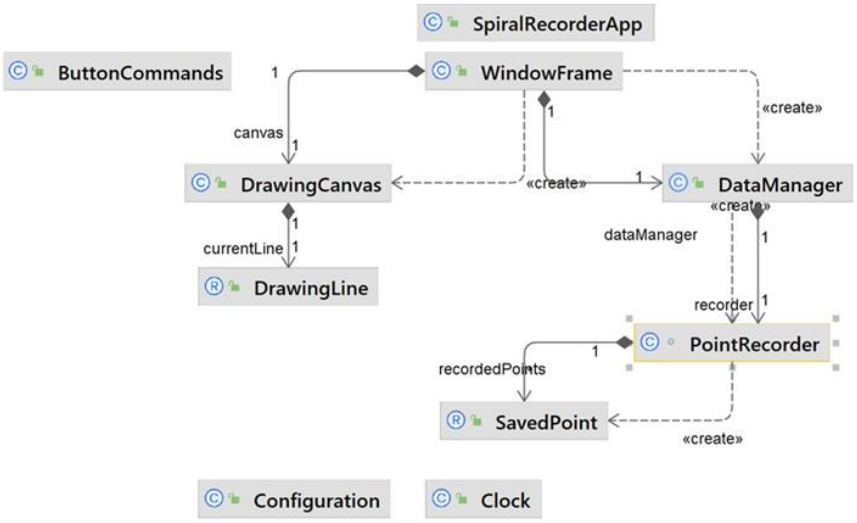
The problem of movement disorders, particularly essential tremor (ET), is relevant for many people. To improve a person's condition, accurate diagnosis at various stages of treatment is important. For this purpose, various diagnostic methods have been developed, those using modern technologies being especially popular due to convenience, mobility, and accuracy. Various devices can be used, including smartphones and graphics tablets [1].

When using a digitizer, the method of drawing the Archimedean spiral is usually implemented. Spirals and straight lines are patterns that are used the most in the clinical evaluation procedure for ET. Data gathering about pen tip location, pressure exerted, and tilt angles is made easier with the use of digital graphic boards. Pen tip coordinates have been analyzed using a variety of methods, including polar (radius and angle) and Cartesian (y-x-position) coordinates. Many metrics, such as changes in radius per angle, radial error, and deviation analysis from an ideal or pre-established spiral, have been reported to spiral frequency and time. Variations from the initial point have also been investigated. Studies have also looked at things like the spiral's principal tremor axis and spiral width variability [2].

Software used for ET diagnosing is to fulfil a certain set of requirements:

- The software should enable motion capture using a graphics tablet, accounting for errors and environmental factors.
- Data should include duration, intensity, and characteristics of motions such as coordinates and pen pressure values.
- The program should record these motions in a convenient data analysis format, including metadata like tablet technical specifications and recording start time.
- Technical considerations include cross-platform compatibility for universality and minimizing software layer delays.
- Challenges in implementation may arise from minimizing latency, varying OS drivers' effectiveness, and differences in tablet hardware characteristics.
- Establishing a reference point for coordinate registration is vital, given potential hardware discrepancies.

For the research purposes, a prototype for receiving data from a graphic tablet has been created. The technologies chosen were the Java programming language and the JPen library for reading tablet input [3] and Swing for implementing the graphical interface. JPen detects connected graphic tablets using platform-specific APIs or drivers provided by tablet manufacturers [3] (Wintab-Windows, Cocoa-MacOS, XIput-Linux). The library employs an event-driven architecture, where developers register event listeners to handle various pen input events (presses, releases, movements, pressure changes, tilts, and rotations). When an event occurs, JPen triggers the corresponding event listener, passing relevant data along with a timestamp. The class diagram of the created solution is shown in Figure 1.



absoluteTime	registeredTime	scheduledTime	registeredDelta	scheduledDelta	x	y	tiltX	tiltY	pressure
1713093388110	0:0:0.731	0:0:0.732	0:0:0.000	0:0:0.000	62.37900000	-53.59575000	0.00000000	0.000000	
1713093388115	0:0:0.736	0:0:0.736	0:0:0.005	0:0:0.004	62.37900000	-53.41650000	0.00000000	0.000000	

Figure 1: The class diagram of the prototype for motion capture

The DrawingCanvas and DataManager are important components, responsible for displaying the image on the screen and writing the input data from the tablet to a file for further analysis, respectively. The above figure shows the format of the collected data, with absoluteTime as the timestamp of the drawing event, registered (by tablet) and scheduled (library issued the event) times. Accordingly, delta fields show the time differences. Next are the coordinate values, the pen tilt on both axes and the pressure at that moment in time, representing the full set of data needed for the ET diagnosing.

References

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2. M. Petryk et al. Analysis technology of neurological movements considering cognitive feedback influences. CEUR Workshop Proceedings 3309 (2022): 45–54.

3. JPen documentation. URL: https://jpen.sourceforge.net/html-home/index.html