17 July 2025

INTRODUCTION TO KEYSTROKE DYNAMICS

by:

Assoc. Prof. Ts. Dr. Syed Zulkarnain Syed Idrus

Associate Professor, Ph.D., P.Tech

Department of Computer

Faculty of Intelligent Computing (FIC)

Universiti Malaysia Perlis (UniMAP)

Life Member of Amity University Network (AUN) Research Labs, INDIA

Head of Research Cluster (Computing & Security), Centre of Excellence for Advanced Communication Engineering (ACE), UniMAP, MALAYSIA

A QUICK GLIMPSE

1997 **North Trafford College (NTC)**, Manchester, United Kingdom
BTEC ND in Information Technology Applications

2001 **University of Manchester Institute of Science and Technology (UMIST)**, Manchester, United Kingdom
B.Sc. in Information Systems Engineering

2008 **Universiti Malaysia Perlis (UniMAP)**, Perlis, Malaysia
M.Sc. in Computer Engineering (research-based)

2015 **Université de Caen Basse-Normandie (UniCAEN)**, Caen, Normandy, France
Doctorat Informatique et Applications
(Ph.D. in Computer Science and Applications)

RESEARCH EXPERTISE & INTEREST

- RE: Information and Computing Technology, Computer Security, Biometrics, Keystroke Dynamics, and Pattern Recognition

- RI: Artificial Intelligence, Cybersecurity, Biometrics (refer to Figure 1), Internet of Things (IoT), Big Data, Data Security and Privacy

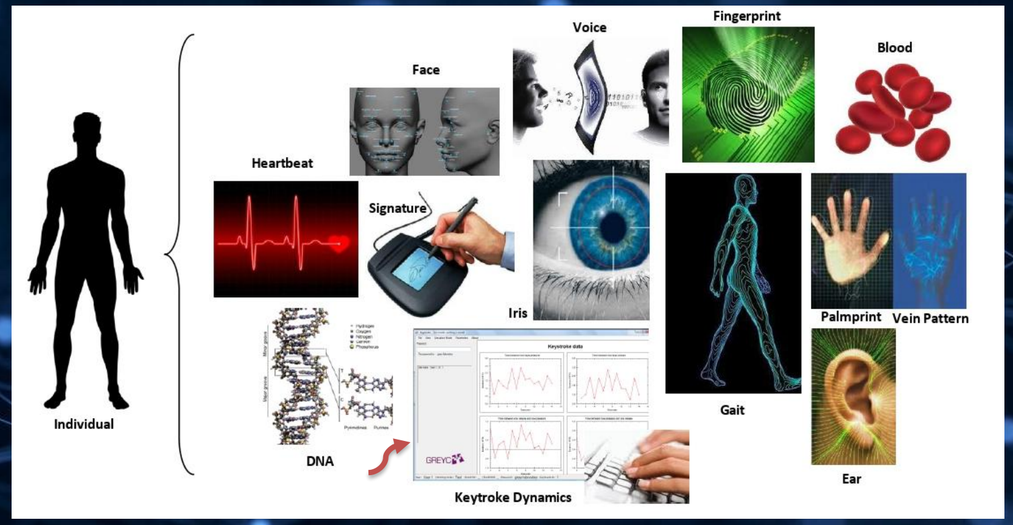
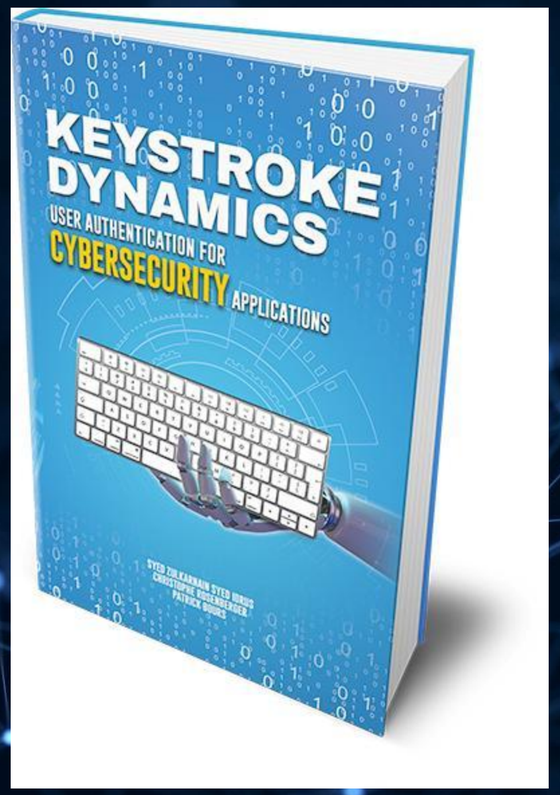


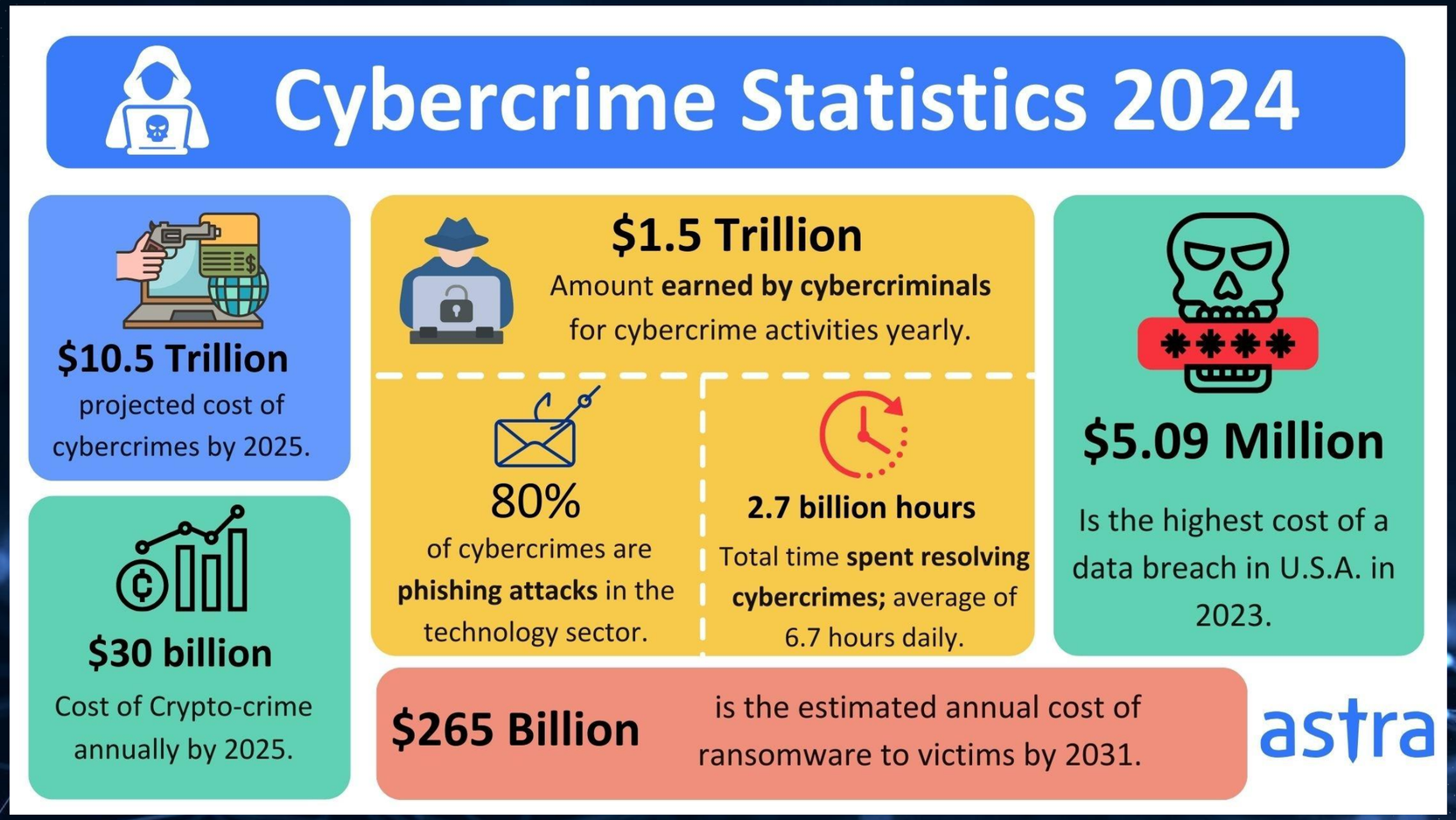
Figure 1: Biometrics modalities illustration with keystroke dynamics as speciality.

BOOKS PUBLISHED ON CYBERSECURITY AND ONLINE SCAMMING



May 2025

CYBER THREATS RISING

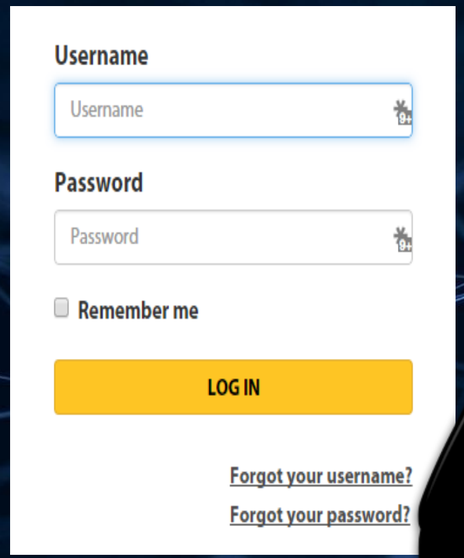


Source: Cybercrime Statistics 2024 (Astra Security, 2024)

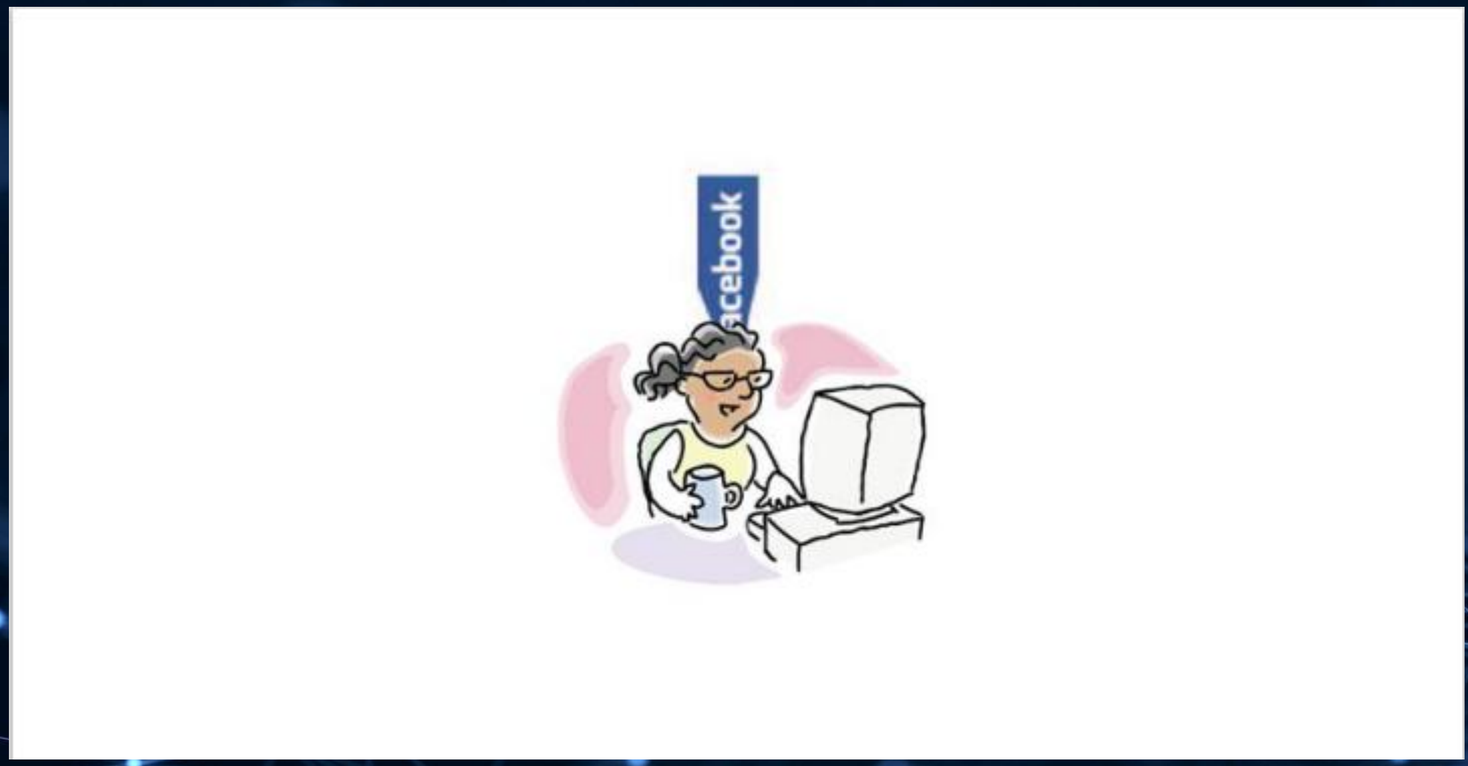
SECURITY ISSUES IN RELATION TO COMPUTER

A person's **authentication** can be the means of accessing a computer or software on computers or websites.

E.g. he/she may be asked by the system to provide their **username and password** (Idrus *et al.*, 2013).



SECURITY ISSUES IN RELATION TO COMPUTER



SECURITY ISSUES IN RELATION TO COMPUTER

SECURITY ISSUES IN RELATION TO COMPUTER

SOLUTION: BIOMETRICS

- *Morphological* is related to the shape of the body such as retina, voice, prints (finger, thumb, palm), iris, hand geometry, face recognition, ear, height, weight, skin, veins, gender...
- *Biological* is related to the inner part of a living organism such as heartbeat, odour, DNA, blood ...
- *Behavioural* is related to the behaviour of a person such as gait, signature, **keystroke dynamics**, voice, driving, gaming, and others ...

WHAT IS KEYSTROKE DYNAMICS BIOMETRICS?

- It belongs to the class of behavioural biometrics, in the sense that the template of a user reflects an aspect of **his/her behaviour**.

- Generally speaking, the global performances of keystroke dynamics-based authentication systems are **lower** than those of popular morphologic modalities-based authentication systems (such as fingerprints, iris, etc. . .).

MOTIVATIONS TO Keystroke Dynamics

01

Low Implementation Cost

02

Non-Intrusive and Continuous

03

Difficult to Mimic or Steal

04

Behavioral Biometrics for Enhanced Security

1. Low Implementation Cost

- **Reason:** Keystroke dynamics relies on data from standard input devices (keyboards) already available on nearly all devices.
- **Advantage:** No need for specialized biometric hardware (e.g., fingerprint scanners or iris readers), making it easy to deploy at scale.

Summary

Keystroke dynamics uses existing keyboards, eliminating the need for extra hardware and reducing deployment costs.

2. NON-INTRUSIVE AND CONTINUOUS

- **Reason:** Keystroke patterns can be monitored passively during normal user interaction.
- **Advantage:** Users don’t need to interrupt their workflow for authentication, and it allows for **continuous authentication** throughout a session.

Summary

It works silently in the background, allowing seamless and ongoing user authentication without disrupting workflow.

3. DIFFICULT TO MIMIC OR STEAL

- **Reason:** Typing rhythm, speed, and latency are influenced by neuromuscular characteristics, which are unique and hard to replicate.
- **Advantage:** Provides an additional layer of security beyond passwords, especially against credential theft or shoulder surfing.

Summary

Typing patterns are unique and hard to replicate, making this method more secure against impersonation or data theft.

4. BEHAVIORAL BIOMETRICS FOR ENHANCED SECURITY

- **Reason:** As a behavioral biometric, it adds depth to authentication by analyzing *how* something is typed rather than just *what* is typed.

- **Advantage:** Enables **multi-factor authentication (MFA)** by combining knowledge-based (passwords) and behavior-based inputs for stronger identity assurance.

Summary

It analyzes how a user types, adding a behavioral layer to authentication for stronger identity verification.

Solution (New Dimension) → BIOMETRICS : Keystroke Dynamics

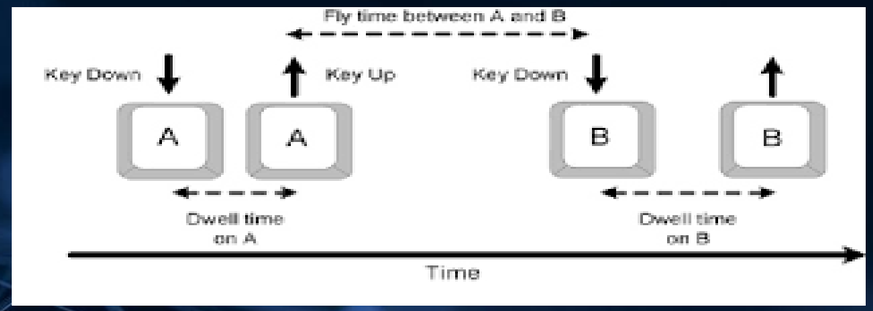


Figure 1: Keystroke typing features to capture typing rhythms

U – N – I – V – E – R – S – I – T – I - __ - M – A – L – A – Y – S – I – A - __ - P – E – R – L – I – S

Solution (New Dimension) → BIOMETRICS : Keystroke Dynamics

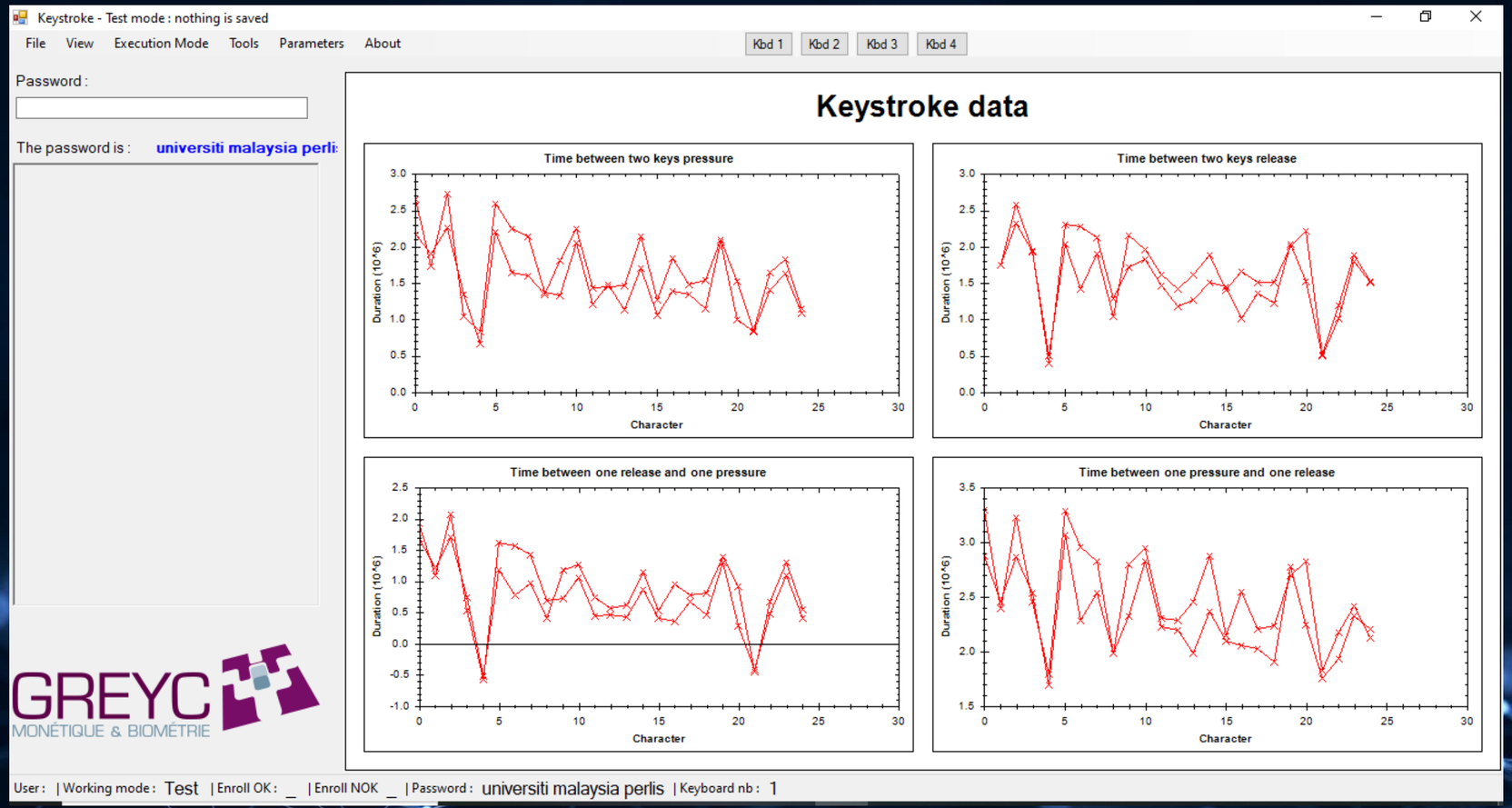
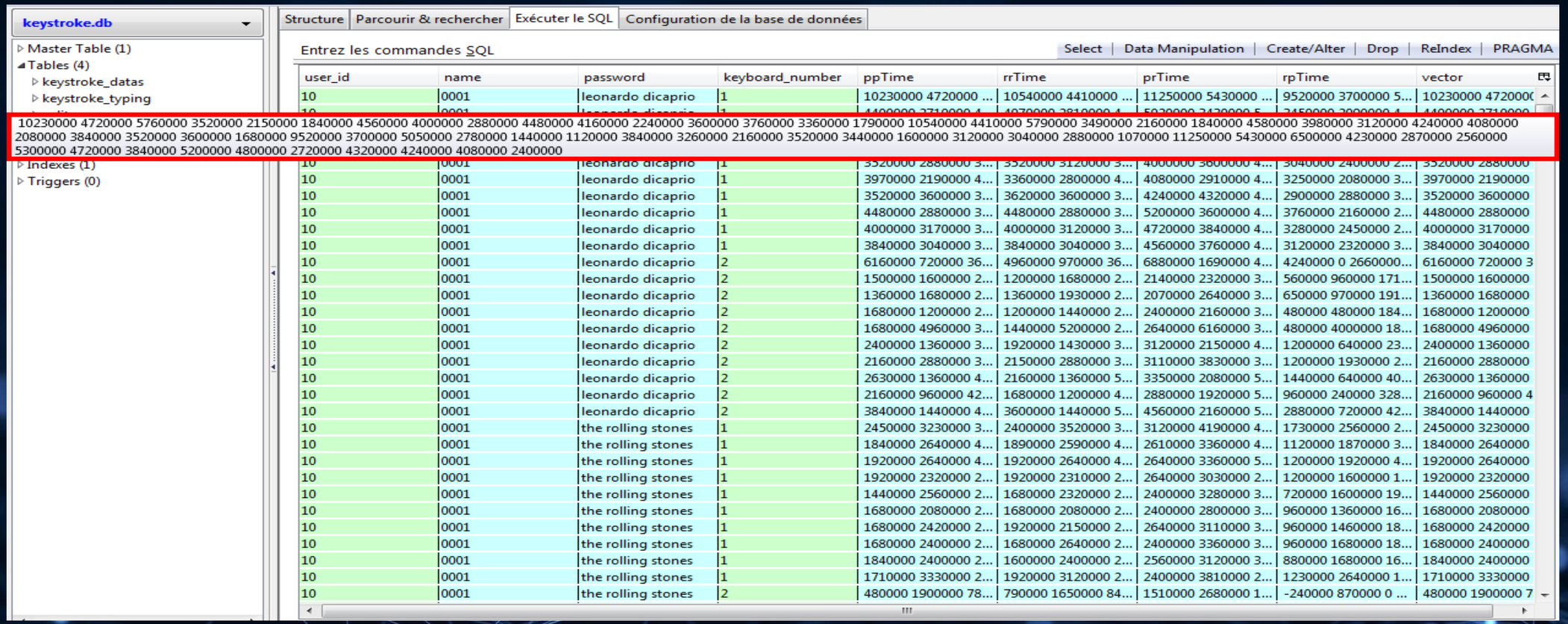


Figure 2: GREYC software (Giot *et al.*, 2011)

Solution (New Dimension) → BIOMETRICS : Keystroke Dynamics



user_id	name	password	keyboard_number	ppTime	rrTime	prTime	rpTime	vector
10	0001	leonardo dicaprio	1	10230000 4720000 ...	10540000 4410000 ...	11250000 5430000 ...	9520000 3700000 5...	10230000 4720000
10	0001	leonardo dicaprio	1	3970000 2190000 4...	3360000 2800000 4...	4080000 2910000 4...	3250000 2080000 3...	3970000 2190000
10	0001	leonardo dicaprio	1	3520000 3600000 3...	3620000 3600000 3...	4240000 4320000 4...	2900000 2880000 3...	3520000 3600000
10	0001	leonardo dicaprio	1	4480000 2880000 3...	4480000 2880000 3...	5200000 3600000 4...	3760000 2160000 2...	4480000 2880000
10	0001	leonardo dicaprio	1	4000000 3170000 3...	4000000 3120000 3...	4720000 3840000 4...	3280000 2450000 2...	4000000 3170000
10	0001	leonardo dicaprio	1	3840000 3040000 3...	3840000 3040000 3...	4560000 3760000 4...	3120000 2320000 3...	3840000 3040000
10	0001	leonardo dicaprio	2	6160000 720000 36...	4960000 970000 36...	6880000 1690000 4...	4240000 0 2660000...	6160000 720000 3
10	0001	leonardo dicaprio	2	1500000 1600000 2...	1200000 1680000 2...	2140000 2320000 3...	560000 960000 171...	1500000 1600000
10	0001	leonardo dicaprio	2	1360000 1680000 2...	1360000 1930000 2...	2070000 2640000 3...	650000 970000 191...	1360000 1680000
10	0001	leonardo dicaprio	2	1680000 1200000 2...	1200000 1440000 2...	2400000 2160000 3...	480000 480000 184...	1680000 1200000
10	0001	leonardo dicaprio	2	1680000 4960000 3...	1440000 5200000 2...	2640000 6160000 3...	480000 4000000 18...	1680000 4960000
10	0001	leonardo dicaprio	2	2400000 1360000 3...	1920000 1430000 3...	3120000 2150000 4...	1200000 640000 23...	2400000 1360000
10	0001	leonardo dicaprio	2	2160000 2880000 3...	2150000 2880000 3...	3110000 3830000 3...	1200000 1930000 2...	2160000 2880000
10	0001	leonardo dicaprio	2	2630000 1360000 4...	2160000 1360000 5...	3350000 2080000 5...	1440000 640000 40...	2630000 1360000
10	0001	leonardo dicaprio	2	2160000 960000 42...	1680000 1200000 4...	2880000 1920000 5...	960000 240000 328...	2160000 960000 4
10	0001	leonardo dicaprio	2	3840000 1440000 4...	3600000 1440000 5...	4560000 2160000 5...	2880000 720000 42...	3840000 1440000
10	0001	the rolling stones	1	2450000 3230000 3...	2400000 3520000 3...	3120000 4190000 4...	1730000 2560000 2...	2450000 3230000
10	0001	the rolling stones	1	1840000 2640000 4...	1890000 2590000 4...	2610000 3360000 4...	1120000 1870000 3...	1840000 2640000
10	0001	the rolling stones	1	1920000 2640000 4...	1920000 2640000 4...	2640000 3360000 5...	1200000 1920000 4...	1920000 2640000
10	0001	the rolling stones	1	1920000 2320000 2...	1920000 2310000 2...	2640000 3030000 2...	1200000 1600000 1...	1920000 2320000
10	0001	the rolling stones	1	1440000 2560000 2...	1680000 2320000 2...	2400000 3280000 3...	720000 1600000 19...	1440000 2560000
10	0001	the rolling stones	1	1680000 2080000 2...	1680000 2080000 2...	2400000 2800000 3...	960000 1360000 16...	1680000 2080000
10	0001	the rolling stones	1	1680000 2420000 2...	1920000 2150000 2...	2640000 3110000 3...	960000 1460000 18...	1680000 2420000
10	0001	the rolling stones	1	1680000 2400000 2...	1680000 2640000 2...	2400000 3360000 3...	960000 1680000 18...	1680000 2400000
10	0001	the rolling stones	1	1840000 2400000 2...	1600000 2400000 2...	2560000 3120000 3...	880000 1680000 16...	1840000 2400000
10	0001	the rolling stones	1	1710000 3330000 2...	1920000 3120000 2...	2400000 3810000 2...	1230000 2640000 1...	1710000 3330000
10	0001	the rolling stones	2	480000 1900000 78...	790000 1650000 84...	1510000 2680000 1...	-240000 870000 0 ...	480000 1900000 7

Figure 3: Vector timing values recorded in a database

Solution (New Dimension) → BIOMETRICS : Keystroke Dynamics

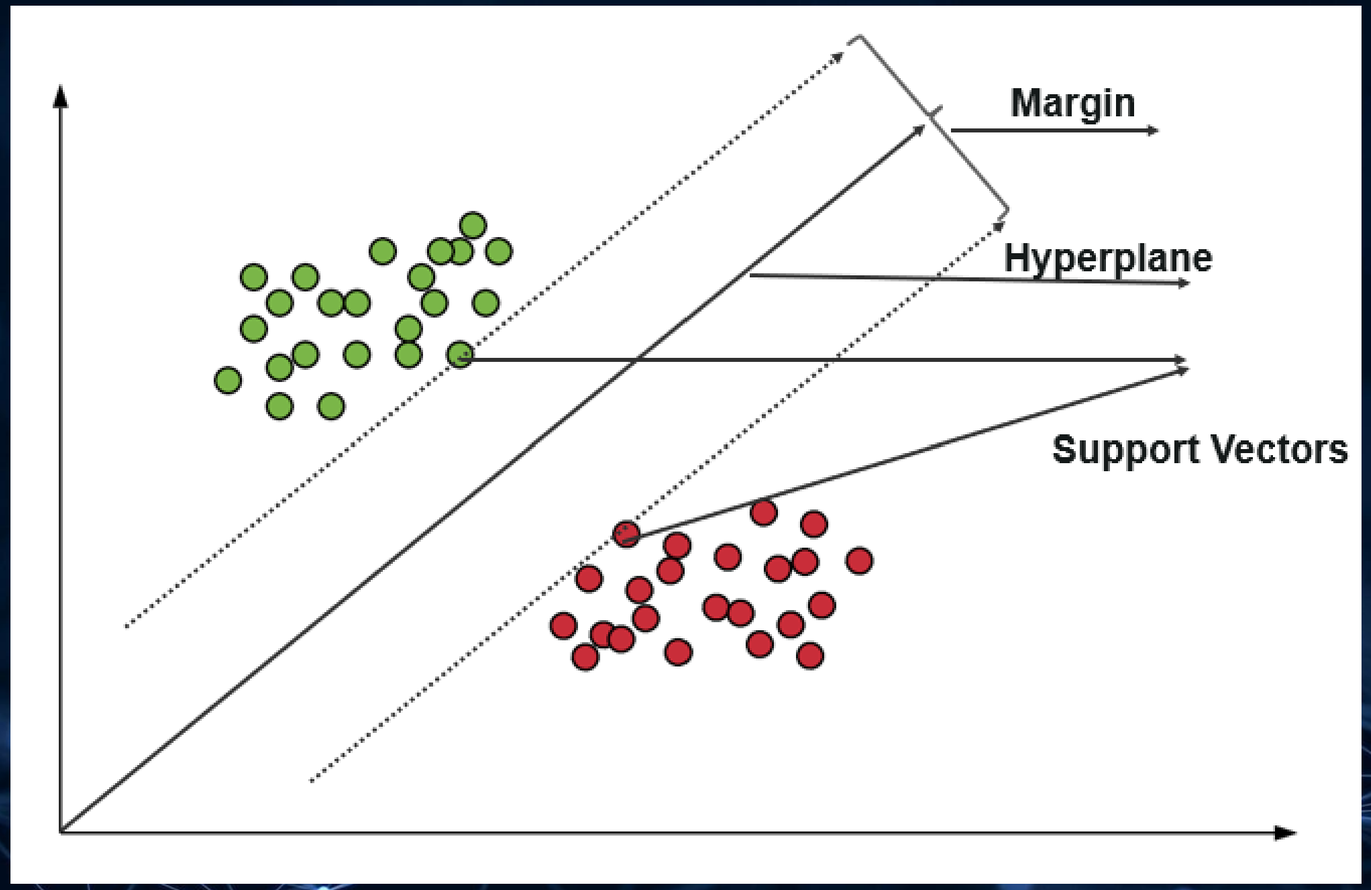


Figure 4: Support Vector Machine (SVM) Classification of Hyperspectral Data Features

ANALYSIS ILLUSTRATION BETWEEN USERS

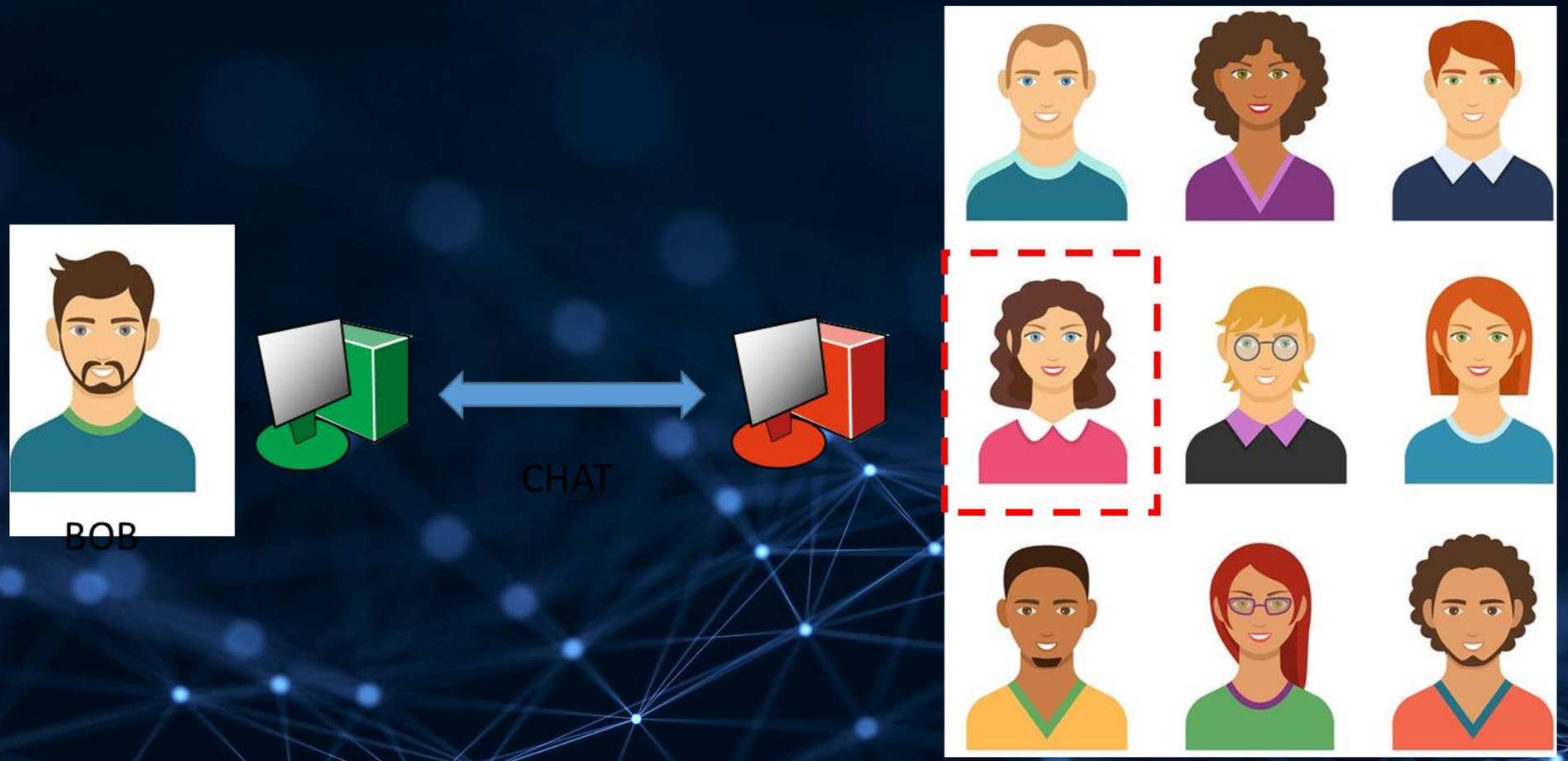


Figure 5: Illustration of the serious game. Bob has to decide if he is talking through a chat to Alice. The keystroke dynamics between Bob and “Alice” will be analysed to make an automatic decision for comparison.

DEMO


Thank
You!