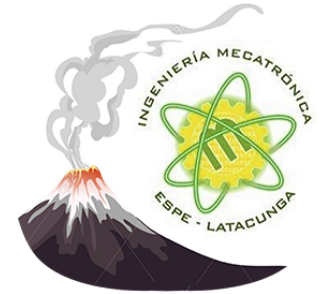




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INNOVACIÓN PARA LA EXCELENCIA

**ARMY FORCE UNIVERSITY– ESPE
DEPARTMENT OF ENERGY AND MECHANICS
MECHATRONIC ENGINEERING DEGREE**



**PAPER TITLE : “SYNERGISTIC INTEGRATION OF TECHNIQUES OF
VC, COMMUNICATION TECHNOLOGIES AND UNITIES OF
CALCULATION TRANSPORTABLE FOR GENERATE A SYSTEM
EMBEDDED THAT MONITORS PYROCLASTIC FLOWS IN REAL
TIME”**

PRESENTER: BARRERA LLANGA KEVIN IVAN

Langkawi-Malaysia, DECEMBER 2016



Introduction:

- ❖ A volcano is a rupture in the crust of Earth, that allows hot lava, volcanic ash, and gases to escape from a magma chamber below the surface.
- ❖ Mount Tambora in Indonesia, caused 82,000 direct victims in 1815
- ❖ In 2015 in the province of Cotopaxi, Ecuador was put in a state of emergency due to the possible reactivation of the volcano in this area, causing panic among the inhabitants of the villages.



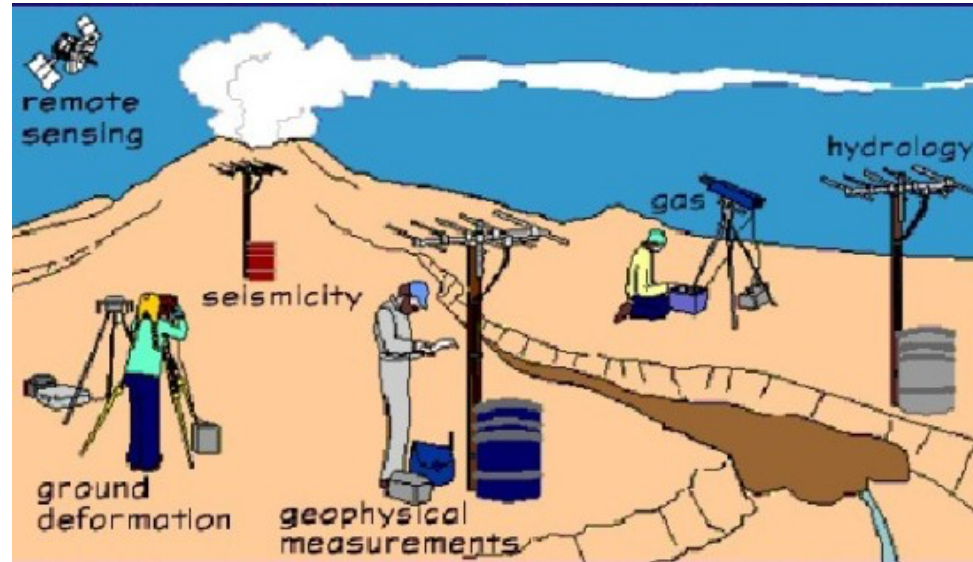
Mount Tambora



Cotopaxi Volcano

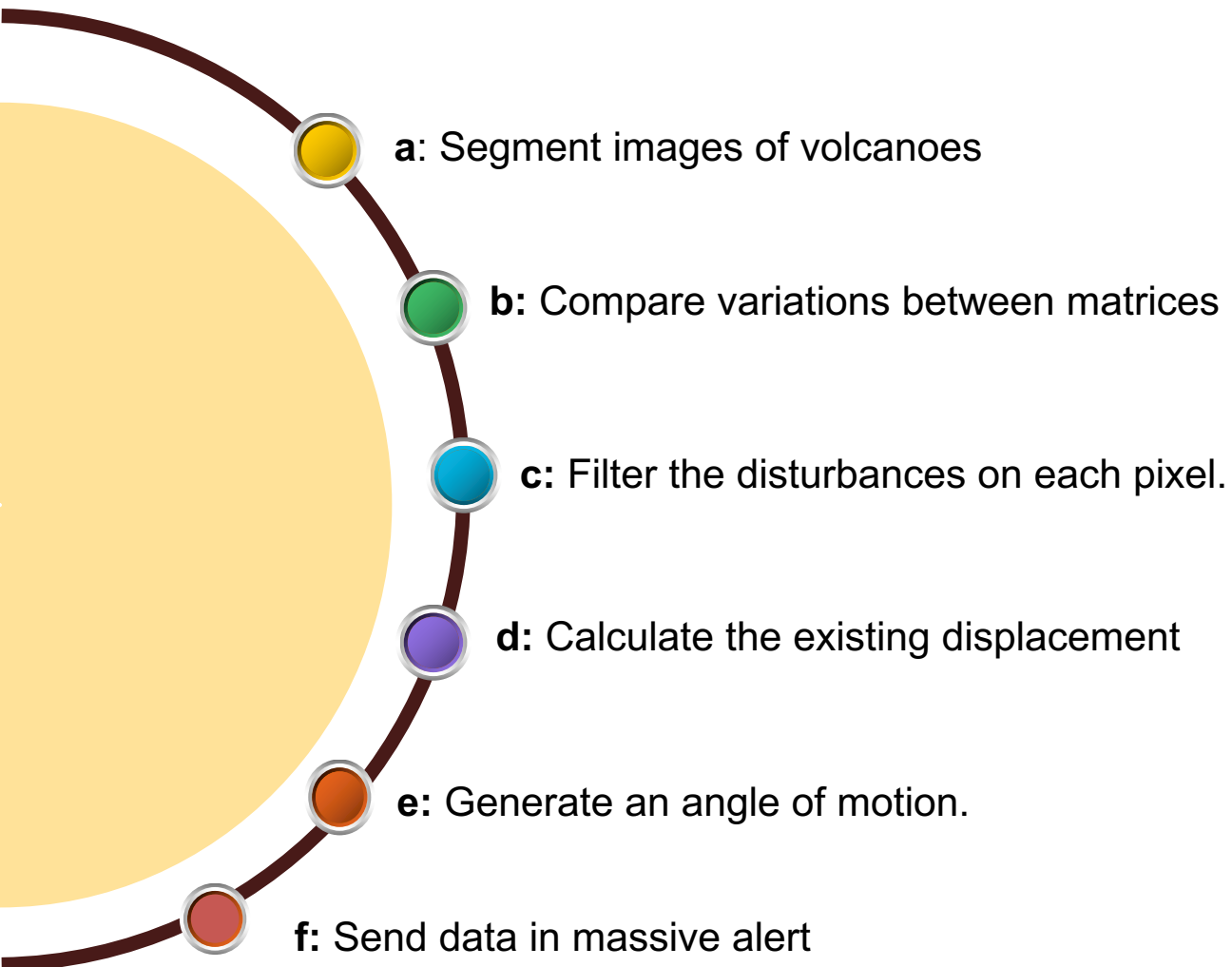


Bibliographical review



- ❖ A person was designated to night and day watch if a volcano changed state.
- ❖ Using VC (computer vision) in embedded systems we can obtain a greater precision in the acquisition of data in real time





Cameras of the Geophysical Institute of Ecuador



Characteristics:

1. Resolution of 2560x1440 pixels
2. Aperture f/1.4-5.6
3. Electronic inclinometers
4. Infrared Vision
5. Thermal Vision
6. Internal Battery

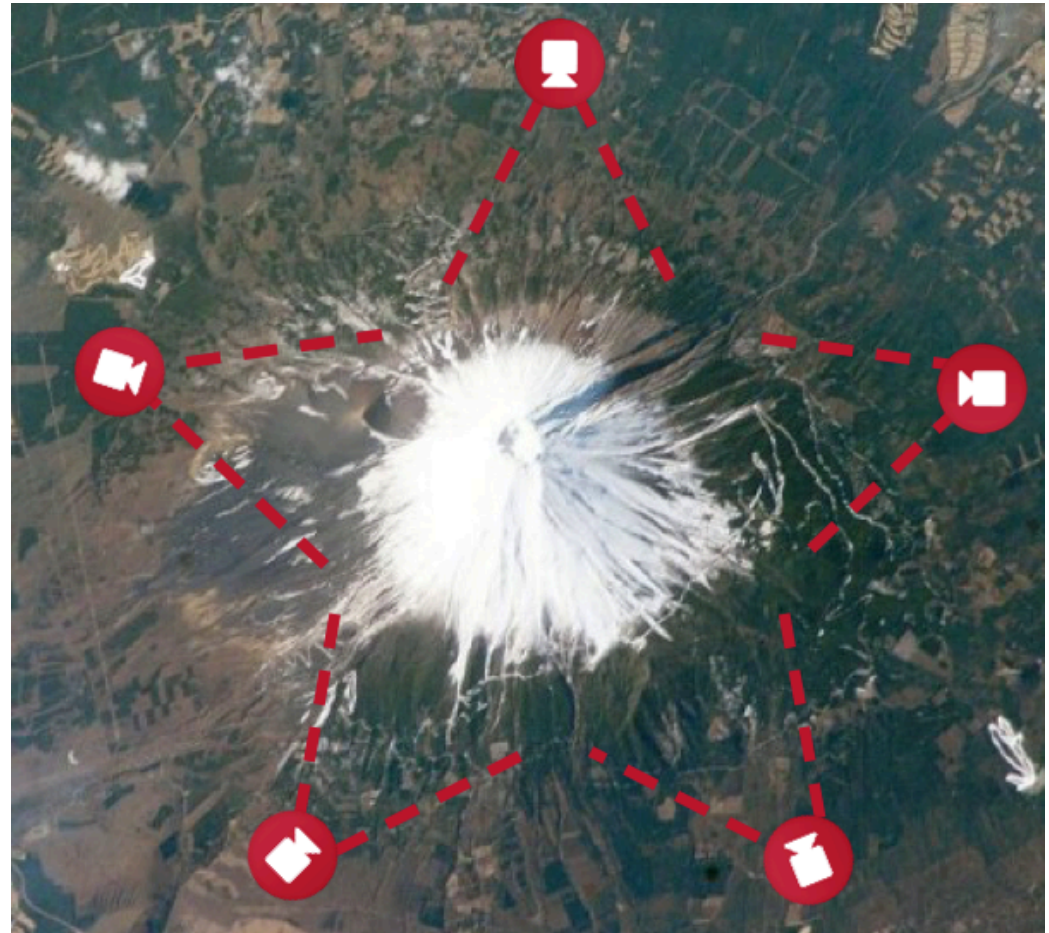


Image Processing



1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49



1	2	3	4	5	6	7
8	9	10	11	4	13	14
15	16	17	18	19	4	21
22	23	24	25	26	4	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
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22	23	24	25	26		28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49



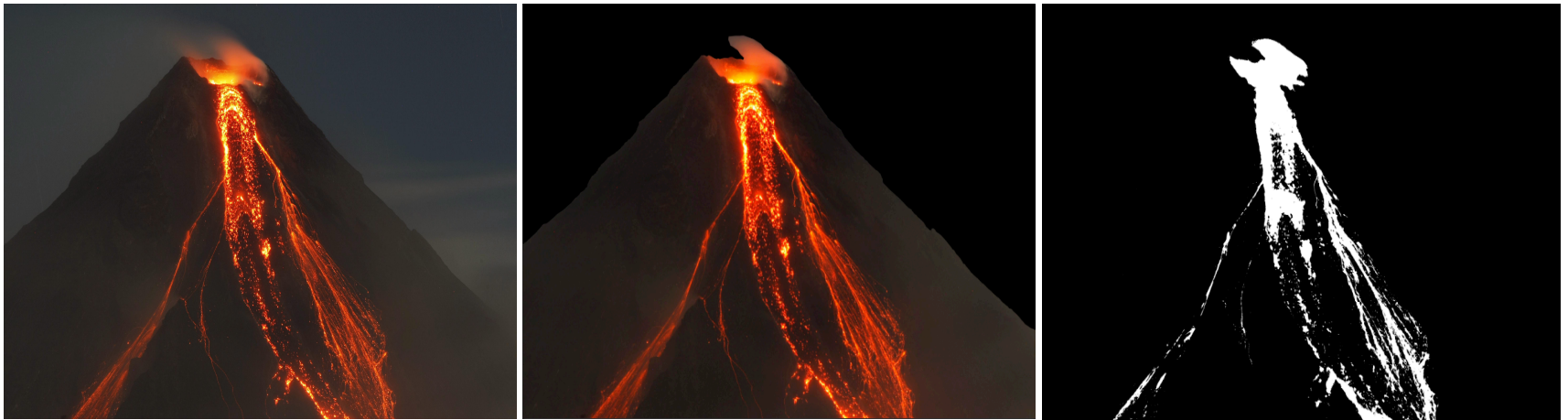
Functions in Open CV

Automatically record video of the data obtained and comparison by layers:

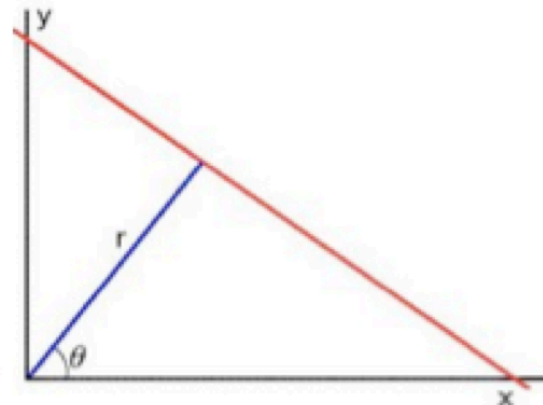
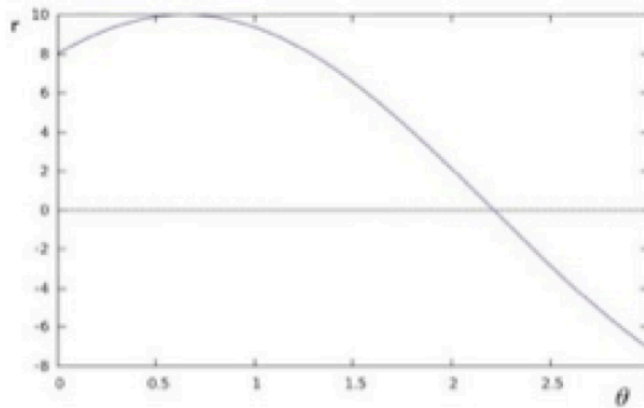
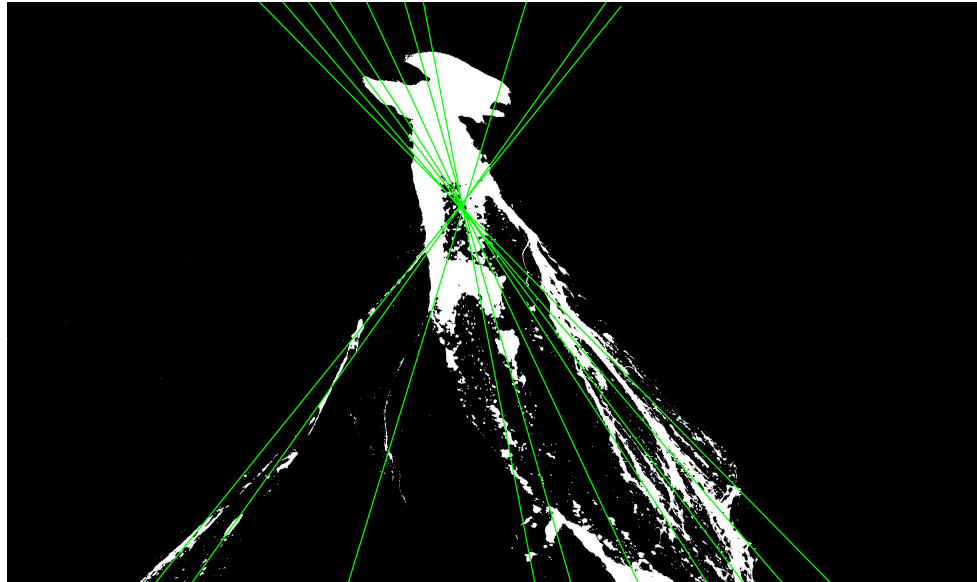
```
VideoWriter grab() y capture.set();
```

Segment and filter images of volcano:

```
cvtColor();inRange();  
morphOps();  
trackFilteredObject();  
erodeElement = getStructuringElement(  
MORPH_RECT,Size(2,1));  
dilateElement = getStructuringElement(  
MORPH_RECT,Size(4,2));
```



Determination of trajectories



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Arduino Monitoring

192.168.0.102

ESPE MECATRONICA

Vision artificial con sistemas embebidos para monitoreo de Volcanes en el Ecuador

DATOS DE MONITOREO

Comprobar Alarma

ALARMA = 0x1

Comprobar SERVO

SERVO = 40 GRADOS

Distancia CAMARA-VOLCAN

0 cm

ALERTA...ERUPCION!!

HTML Page in Arduino

The mac address: `byte mac[] = { 0xDE, 0xAD, 0xBE, 0xEF, 0xFE, 0xED };`
Server IP: `byte ip[] = { 192, 168, 0, 120};`
IP of the web page: `byte gateway[] = { 192, 168, 0, 1 };`
Submask: `byte subnet[] = { 255, 255, 255, 0 };`
The communication port: `EthernetServer server(80);`

Remote Monitoring



Overflying Cotopaxi volcano Ecuador, using portable Android application

Interfaces

Interface PC



Interface Android

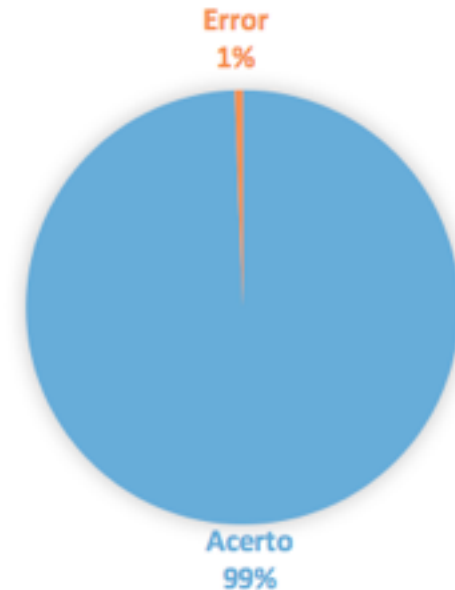
Experimental Results

⊕

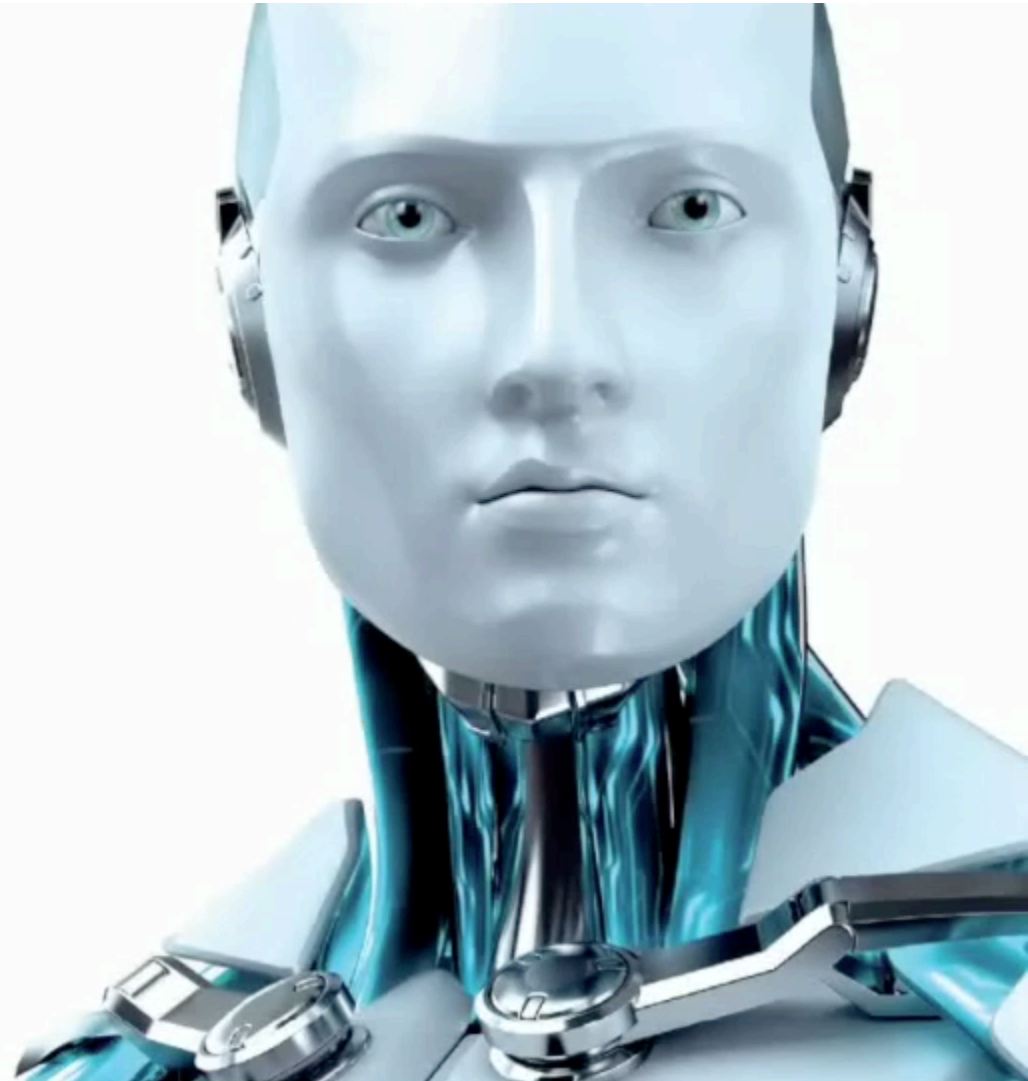
Table.1. Result, test volcanic eruptions

TESTS		DETECTION
1	350T	100%
2	100T	100%
3	250T	100%
4	590T	98%
5	160T	100%
6	480T	100%
7	560T	99%
8	420T	100%
9	650T	97%
10	360T	100%
Result	Succ	99.40%
	Error	0.60%

PORCENTAJE DE FUNCIONAMIENTO



Experimental Results Video



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CONCLUSION



- ❖ The program helps to have a permanent monitoring every day of the year with a great field of accuracy.
- ❖ Determines each type of flow, the area it presents, it's possible trajectories depending on the behavior of the volcano.
- ❖ Enclosing the area and determining the exact positioning of the center of the same with respect to the camera.

- ❖ The different operating systems alert both the common user and the operator of this program.
- ❖ The people affected in the eruption can anticipate any kind of catastrophe by visualizing where the lava flows, saving a greater number of lives by using early warnings.
- ❖ This system will help less lives to be lost in future disasters of nature, with the use of new technologies in a field that has not yet been explored in depth.

ACKNOWLEDGMENTS

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• THANKS FOR YOUR ATTENTION

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