MONITORING OF CANCER PATIENTS USING SMARTPHONES SENSOR DATA

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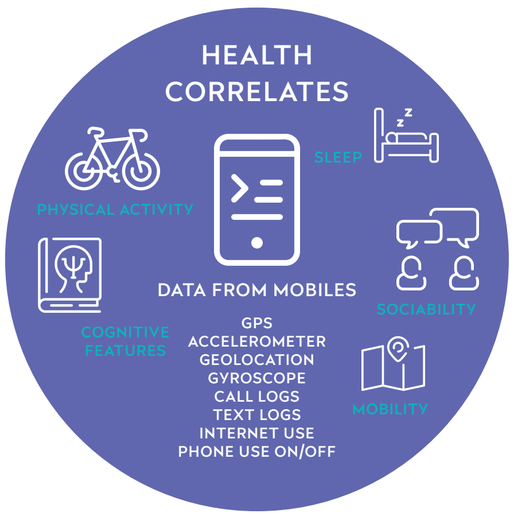
The use of data collection from smartphone devices can provide granular information relevant to illness phenotypes. Types of relevant passively acquired data via smartphone sensors include GPS data to monitor location, accelerometer data to record movement or gross motor activity, and call and messaging logs to document social engagement with others. Such data collection and analysis may be especially beneficial to the monitoring of patients between clinical encounters, as changes in these passively sensed digital biomarkers may reflect significant changes in functional status. Our aim is to optimize the monitoring of cancer patients by developing a model indicating active and passive periods, exertional activity during these periods and passive night-time period of each patient. The proposed approach analyses the variance of passively collected accelerometer data.



DATA FOR ANALYSIS:

- Data is collected by LAIMA Monitoring & Intervention System
- 21 patients
- Recordings of three-axis accelerometer data:
  - Timestamp
  - X coordinate
  - Y coordinate
  - Z coordinate

TIME	X	Y	Z
2021-08-25 00:06:53	0,01947	-0,00521	0,627553
2021-08-25 00:06:57	0,022169	-0,00465	0,629003
2021-08-25 00:06:58	0,020434	-0,00391	0,62429
2021-08-25 00:06:59	0,02	-0,00628	0,625378
2021-08-25 00:11:49	0,025061	-0,00589	0,626788
2021-08-25 00:11:50	0,020563	-0,00961	0,626586

ANALYSIS PROCCESS:

1. The mean of coordinates values was computed for each second.

2. The coordinates values were normalized.

$$x_{normalized} = \frac{x}{\max|x|},$$

3. The variance of accelerometer data was evaluated for each minute m on day d

$$v(d,m) = v_x(d,m) + v_y(d,m) + v_z(d,m),$$

where v_x – the variance of x coordinate values, v_y – the variance of y coordinate values, v_z - the variance of z coordinate values.

4. Period identification:
a) $v(d,m) < 0{,}0001g^2$ – inactive period.
b) Inactive periods that are longer than 60 minutes and separated by active periods of up to 2 minutes were merged.

5. Passive period – the longest inactive period in a day. Active period – the rest of the day

6. Night-time period is passive period, that begins not later that 12 pm. and ends not earlier than 6 pm

7. $v(d,m) < 0{,}15g^2$ – *period of exertional activity.*

RESULTS:

		EXERTIONAL ACTIVITY (HOURS)			NIGHT-TIME PERIOD				PASSIVE PERIOD		
DATE	WEEKDAY	ACTIVE PERIOD	PASSIVE PERIOD	RATE OF PASSIVE PERIOD	FROM	TO	DURATION (HOURS)	EFFICIENCY (%)	FROM	TO	DURATUON (HOURS)
2021-10-03	Sunday	0	0	0,66	10-03 19:40	10-04 07:11	11,50	100	10-02 22:20	10-03 09:45	22,42
2021-10-04	Monday	0,07	0	0,41	10-04 21:19	10-05 06:31	9,18	99,80	10-03 19:40	10-04 07:11	11,50
2021-10-05	Tuesday	0,15	0,02	0,48	10-05 19:00	10-06 06:53	11,88	100	10-04 21:19	10-05 06:31	9,18

Fig. 1 Vector norm of the acceleration sensed by the tri-axis accelerometer

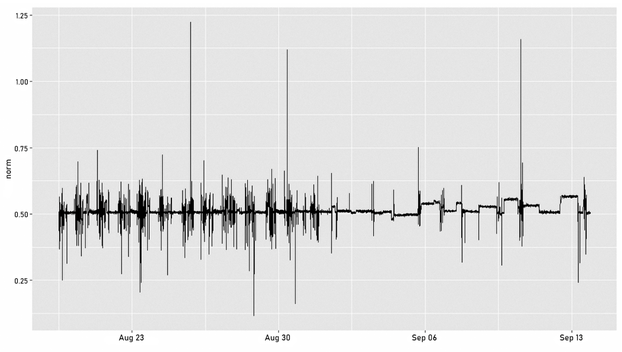


Fig. 2 Example of active periods

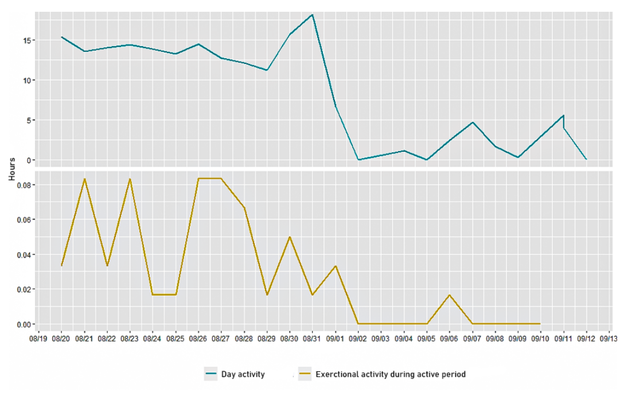
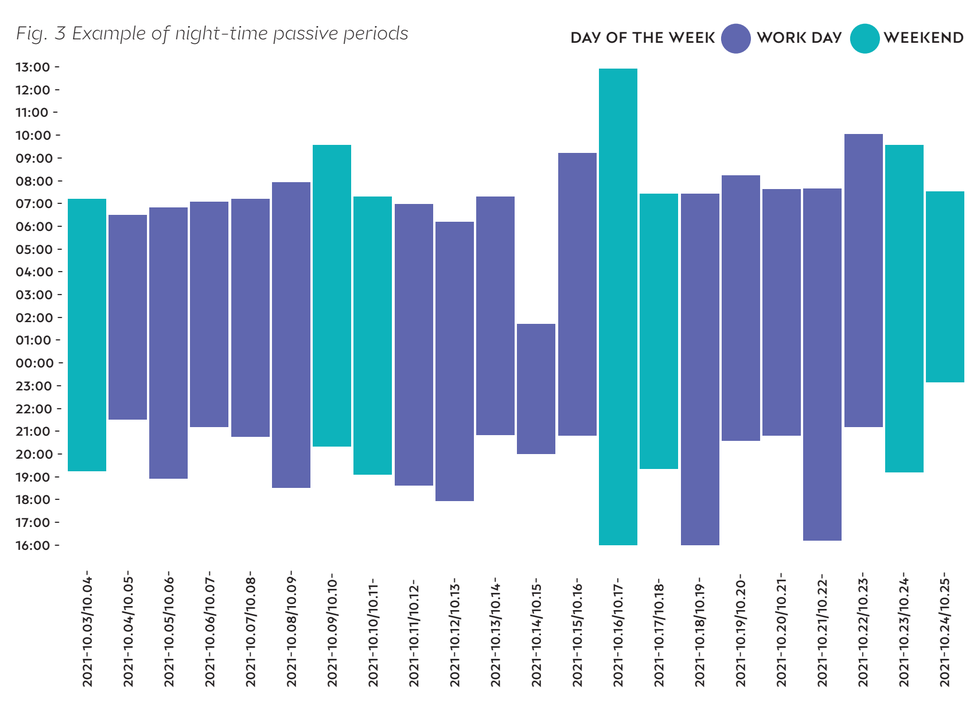


Fig. 3 Example of night-time passive periods



FUTURE PLANS:

To optimize the monitoring of cancer patients by creating a model that forecasts the trajectory of the disease.

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