Synchronization Between Sensors and Cameras in Movement Data Labeling Frameworks

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Introduction

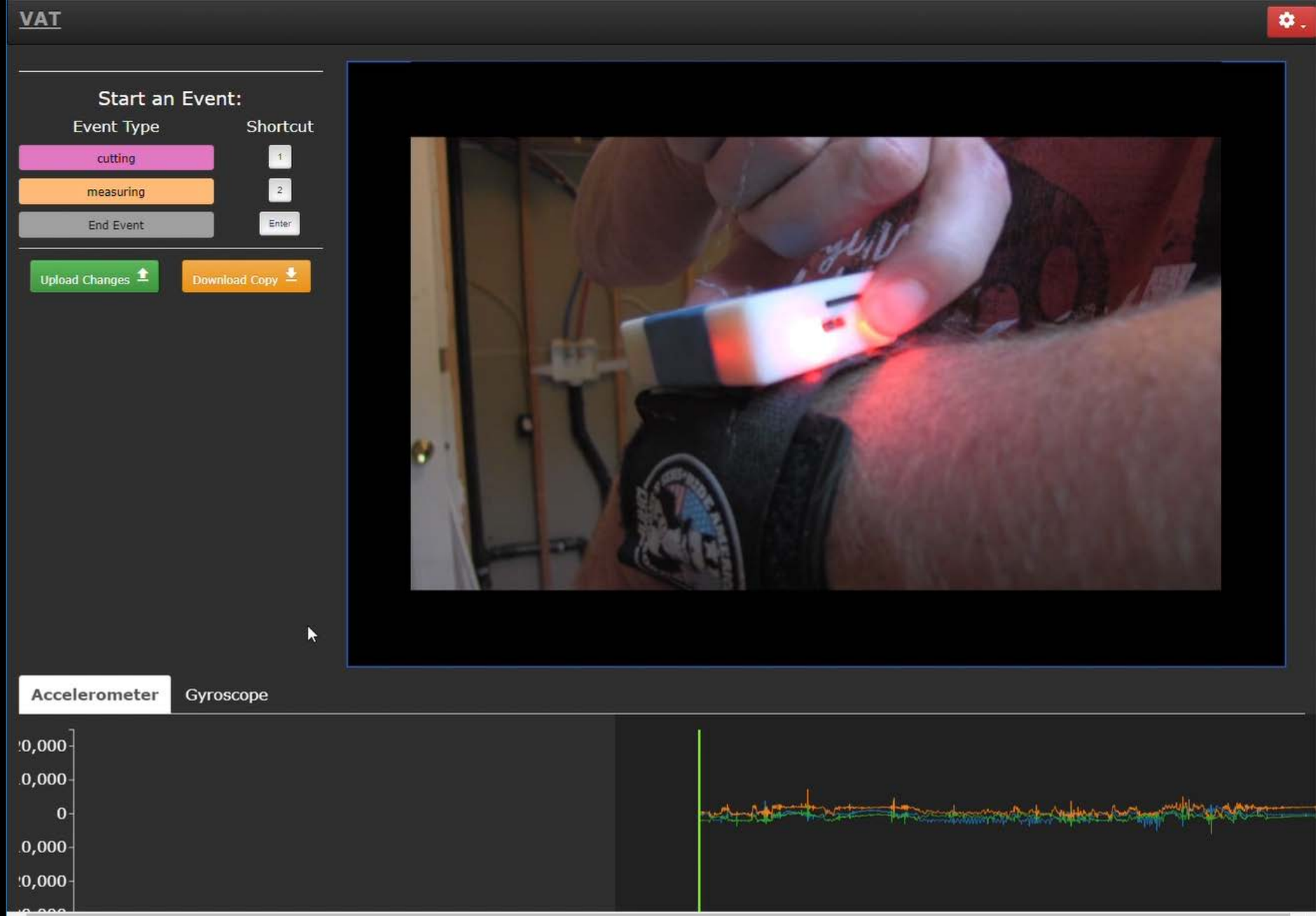
- Obtaining labeled data is a tedious and daunting task
- Ground truth often collected using video that record subjects wearing sensors
- During labeling sensor-data preferably synchronized with video and displayed simultaneously


data_labeling
Files
Label files folder location
easurements Horstlinde\Labels
...
Video folder location
F:\Measurements Horstlinde\2
...
Sensor data location
F:\Measurements Horstlinde\2
...
Current video file: 20180515_17-35-48
Select Video
accel: 20180515_18-17
Select accel. file
Video Controls
15-May-2018
18:44:49
Start: 17:35:48
Stop: 20:35:05
Camera name:Sony4K
Modify
|<<
|>
>>|
Jump to time
18:43:50
Video offset (sec)
0
Sensor offset
0
Jump (sec) on "[" and "]"
8
Labelling
Most recent label: 18:55:09 "unknown"
Last label: 18:57:43 "unknown"
Remove most recent label
Select an activity
lying
standing
walking-rider
walking-natural
trotting-rider
trotting-natural
running-rider
running-natural
grazing
eating
fighting
shaking
scratch-biting
brest-feeding
rubbing
unknown
food-fight
head-shake
OK
Cancel
80
60
40
20
0
walking-rider
standing
18:44:45
18:44:50
18:44:55

Approach Comparison

- Approach A: Synchronization using visual key
- Approach B: Synchronization using real-time clocks

Approach A


VAT
Start an Event:
Event Type
Shortcut
cutting
1
measuring
2
End Event
Enter
Upload Changes
Download Copy
Accelerometer
Gyroscope
0,000
0,000
0
0,000
0,000

Approach A: Synchronization using visual key

- Data logger emits flash and timestamps sensor-data stream
- The first video frame that contains flash is marked by user
- 1 subject per recording
- Synchronization must be repeated for each video

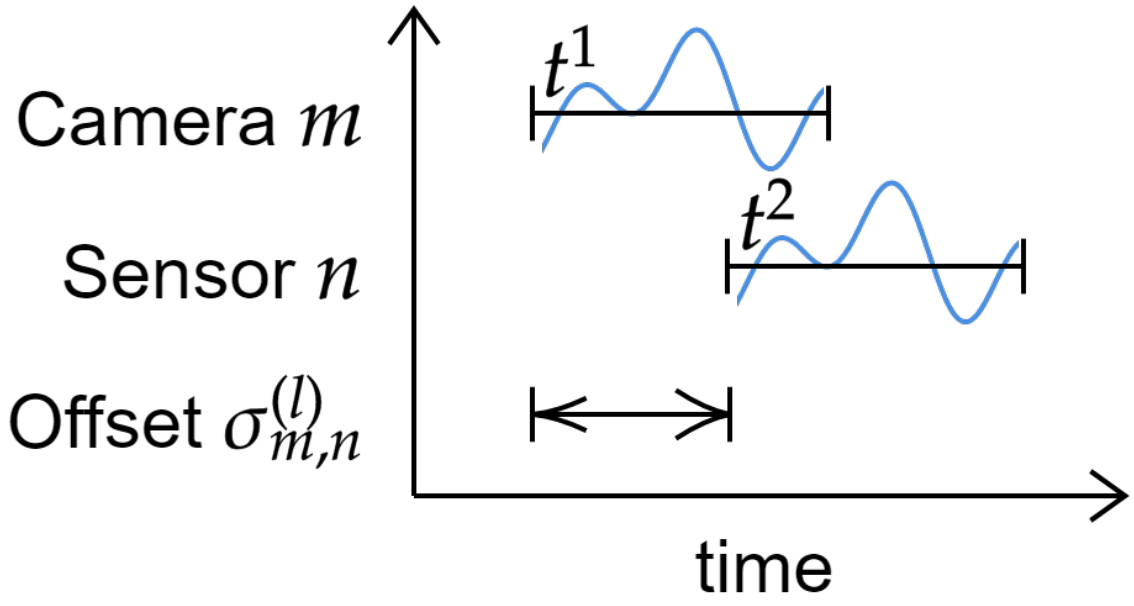
Approach B: Synchronization using real-time clocks

- Assumes camera and datalogger both contain RTC
- RTC coarsely synchronized prior to experiments

Approach B: Synchronization using real-time clocks

- Synchronize on distinctive event in the video and adjust offset $\sigma^{(l)}_{m,n}$ between a given camera *m* and sensor *n* on day *l*

- shake sensors before camera during sync-recording



Comparison

Approach	Advantages	Disadvantages
A: visual key	High accuracy	Only one subject per recording Each video must be synchronized individually
B: RTC	Sync only once Multiple subjects in one video • Easier to collect more data in parallel • Higher chance to record rare activity Easier to use multiple cameras simultaneously Dataloggers can be post-synchronized among each-other	Lower accuracy Susceptive to clock drift

Conclusion

- Timestamped visual keys on the datalogger result in accurate synchronization between sensors data and video

- Using RTC for synchronization allows to monitor multiple subjects simultaneously on same video

Ideas

- Best idea seems to combine both approaches
- Use visual keys on datalogger for both sensor identification and synchronization
- Automatic synchronization by encoding time information in blinking pattern

Thanks for your attention

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