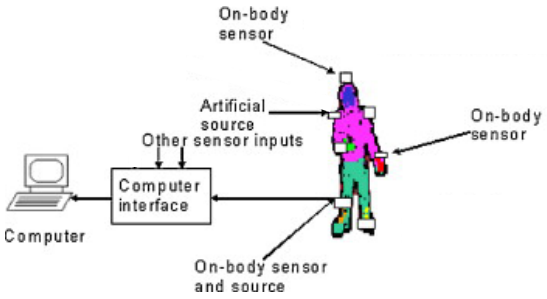
MOVEMENT SIGNATURE MOTION CAPTURE TOOL HACKERS & DESIGNERS

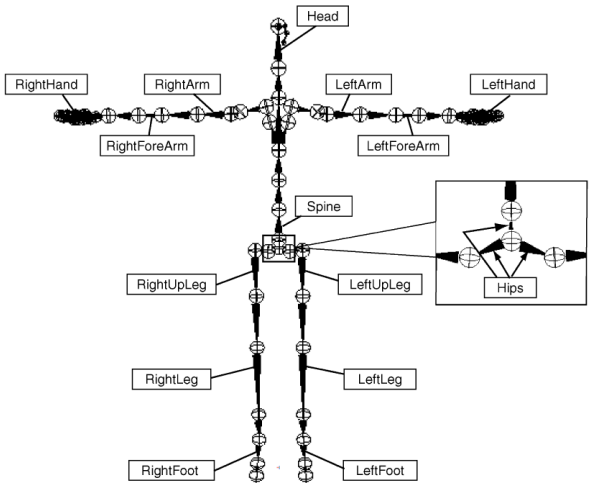
Project Overview and Practicalities
Kiki Mager

September 2019

01 | Scientific visualisation of gait recognition technology, which uses video / viusual detection, not sensors.



02 | Technical overview of motion capture technology using IMU sensors directly attached to the moving body.



03 | Reduced raw motion capture skeletom commonly used in the initial recording of motion data. This skeleton also shows all rotations and junctions. This is more for understanding of the technology, it might not be possible to generate such a detailed skeleton for the DIY tool.

01 | CONTEXT / FRAMEWORK

The science behind human motion capture and how this technology has been informed to analyse human bodies from their movements

Trigger:

Gait recognition (movement signature)

Gait recognition is used in China for public space surveillance. Scientist claim that gait recognition can determine an individual based on their movement with 94% accuracy. I am not fully understanding how, but apparently trying to limb or change the way you walk wont help. The possibility of gait recognition is an extreme example, which however invites to broaden the conversation about how individual body movements are interpreted and used in various fields beyond the entertainment industry.

NY Post, about the application of gait recognition in China

Science Direct, more scientific overview of gait recognition technology

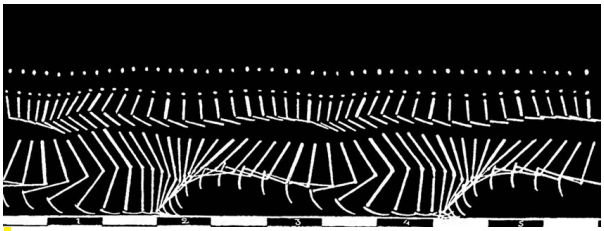
Body Identifying Technologies:

DNA, finger print, iris scan, voice detection, facial recognition, gait recognition (Movement Signature), GPS tracking smartphone

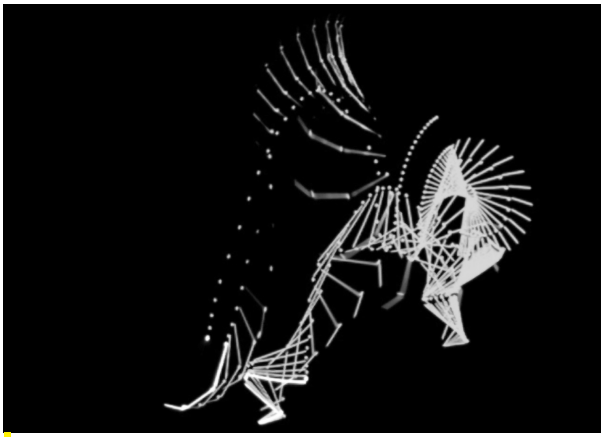
--> from very close to of human body (DNA)
----------> to human body at a distance (Gait, GPS)

02 | PROJECT OVERVIEW

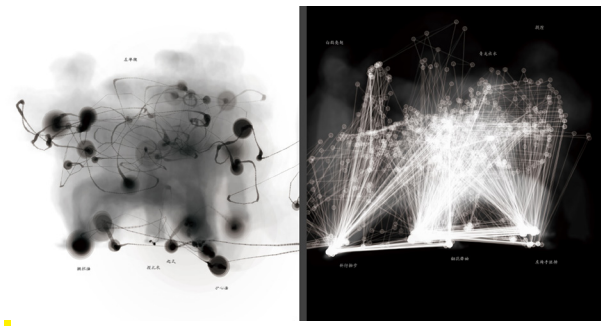
This is a process oriented work which uses the application of Gait Recognition (not its exact technology, which is video-, not sensor-based) as starting point to unfold the complexity behind human motion capture technologies. I would like to invite a range of experts around the field of human motion studies to a series of three workshops in which basic knowledge on human movement is shared and questions on the science, application, benefits/ problematics of motion capture technology can be discussed across fields (health, wellbeing, sports, prosthesis development, surveillance, physically intensive work monitoring, training human motion data to humanoids). This also allows to highlight the different



04 | Depiction of a very early human motion analysis as visual reference for this work.



05 | Early visual motion capture, using image overlay, visualising a person jumping down from a step.



06 | Still visualisation of a recorded Tai Chi motion capture of one person. The visualisation of the collective movement signatures, would be animated to show multiple bodies enacting the same movement pattern with their individual bodily motions. A visual concept needs to be developed that fits the aspect of multiple bodies following the same movement and is able to transmit this logic visually.

types of motion capture technologies that exist (visual image detection, reflector tracking, sensor tracking). The related fields to approach are: Kinesiology, Human Movement Sciences, Motion Capture engineering and data sciences, physiology, professional sport / physique-centred disciplines.

The mobile MoCap tool developed in collaboration with H&D will be used along the workshops with the experts to discuss the technology and allow the audience to experience a raw functioning version of it prior to the show in February 2020; possibly one of the workshops could be held within the show. As the technology is present and accessible directly in the workshop (as DIY MoCap tool), its seemingly scary technical complexity becomes more tangible and questions might be posed more quickly by participants, unfamiliar to such technologies.

These workshops will focus on the friction between the human body and the technology / methodology built to read this human body. The workshops will also include a detour into histories and different knowledges of human movement studies and motion sciences as some basic substance for the discussion.

With the invited experts discipline specific knowledge is introduced. We will enact exercises and analyse individual movements, learn new movements and discuss the science behind gait recognition, how aspects such as health and age can be determined from an individual's movement signature and what benefits and problematics arise in that process.

It might important to inform any possibly participants about the bodily intensive character of these workshops, so that participants are aware that we will possibly work with each our own bodies in a group setting. Just to seek a safe space and prevent any participant from being placed into a triggering situation.

Visually these workshops will generate each their own archive of movements, which will feed the visual and interactive material of the show at Tetem. Throughout the workshops participants will use the tool to perform a motion (A) that the expert proposed. Motion A would be performed by several people along the workshop, generating each their own motion signature for the motion A. These individual movement signatures of motion A are then visualised in a simple overlay of all recorded motion A's and in so, they form the visual representation of a collective movement signature sculpture (s. fig 06 and other reference imagery). These would be simple motion tasks which allow the expert to unfold their strategies of

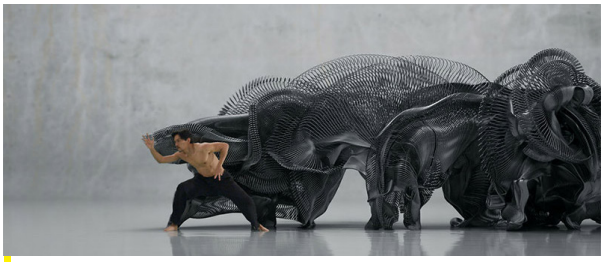
07 | Still from *Asphyxia*, an experimental film project directed by Maria Takeuchi and Frederico Phillips. This work used two XBox Kinect cameras to record movements of dancers.

reading bodily movements and hence a body's state of being (which might be valid or not).

The most interesting part to me is to bring a general audience and different experts together in a space to engage with this technology – the process is the work as such. In this process data will be generated which will inform the shaping of the MoCap tool and also contribute to the visual data displayed within the exhibition context.

I could also imagine that we conduct a workshop at a school, with children able to speak English (since my Dutch is very weak) and through that reach a very different group of voices to interact with, explore and question this tool. In general I think that this work requires to be very conscious about the workshop participants and direct the workshop and invitation with this in mind.

08 | Old motion capture technique, visual overlay of pictures, swinging upper body from side to side.



09 | Still of an animated motion sculpture shown by CCTV (China Central television) Documentary Channel

03 | PRACTICALITIES + Q'S

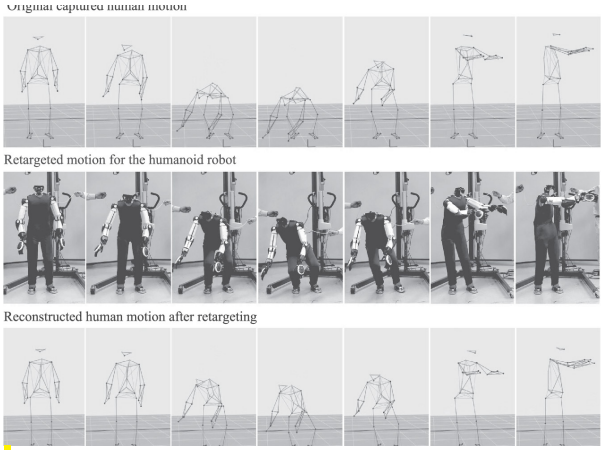
1. ***External consultation: Get in touch with a professional in the sports technology field / human movement studies. Potentially from HUMAN MOVEMENT SCIENCES at VU Amsterdam.***

   About 2 weeks ago I reached out to the department of Human Movement Sciences via m.l.a.leijdekkers@vu.nl and contact@vu.nl, but have not yet received a response.

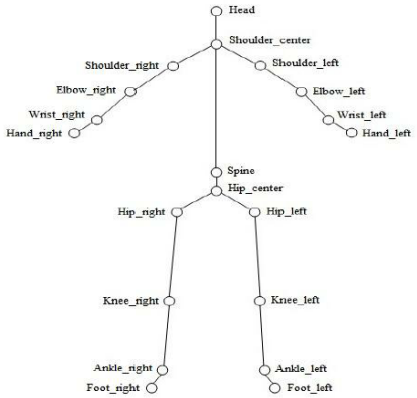
   So meanwhile I also approached a similar department at the Maastricht University, via lex.verdijk@maastrichtuniversity.nl

   There is also this somewhat strange Human Motion Centre in the Netherlands, which provides lessons and courses, but also appears very corporate. I reached out to see if they would be open for providing advise in this artistic work. I did not mention the budget yet, as I wanted to check with you first about this and they might inquire about it in case they are open for an exchange. They are though super not diverse... there is only one women within a total of 28 experts and all of which seem pretty white. I find that strange for a "centre of human motion". So I am a bit unsure if this is a good organisation to engage with they might be able to share some insights though.

2. ***Visual concept and presentation: Further develop the concept for the visual presentation of the work. How will you visualise***

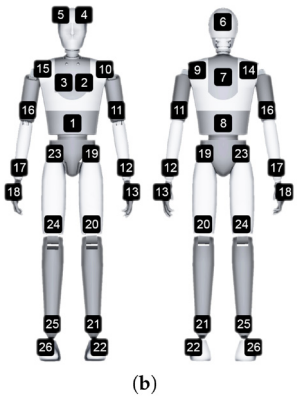


10 | Documentation of the process of teaching human motion capture data to a humanoid robot.



11 | Kinect skeleton listing the tracking locations / markers on the human body, assigned to the data skeleton.

Body Joint, $j \in J$	Level L_i	Dc
Hips	L_0	
Spinebase	L_1	
Neck	L_2	
Head	L_3	
Left Shoulder	L_3	
Left Elbow	L_4	
Left Wrist	L_5	
Left Hand	L_6	
Right Shoulder	L_3	
Right Elbow	L_4	
Right Wrist	L_5	
Right Hand	L_6	
Left Hip	L_1	
Left Knee	L_2	
Left Ankle	L_3	
Left Foot	L_4	
Right Hip	L_1	
Right Knee	L_2	
Right Ankle	L_3	
Right Foot	L_4	



12 | Listing of all IMU sensor positions of an advanced IMU sensor motion capture tool. The DIY MoCap tool will have less.

the movements of the individuals wearing the sensor straps/ belts and the data that is being collected? How will you visualise the difference in movements?

Some references are already in this document, I will follow up with a separate PDF on the visual concept soon.

3. ***Infrastructure for work: What kind of infrastructure do you need to present the work? Will you need screens or will you do a video projection? Are there props that you would need with the work (for example a step for a person to stand on, an object to lift, etc)? It would be great to share this kind of information with our exhibition designer before the end of October.***

I will need a performance space / area in front of the projection. This area can simply be assigned on the floor with taped or somehow indicated line-work. I will possibly need this space to instruct movements and describe movement patterns through the line-work. Would you like me to make a design of this space/ area?

I would like to avoid steps or any obstacles that might prevent certain bodies from engaging with the tool - so this area should be accessible and not require any steps.

I am still ambiguous if I might need 1 tool / basic object (stick or cube or any simple easy to lift and grasp shape) which would be used for one motion activity. But I will get back on that.

I will need a basic structure / frame from which the different sensor straps can be taken and placed back after usage. Possibly the exhibition designer could include this in their designs. I will share more details and some visual thoughts with you before the end of October.

And I'll need electricity, projection, space for the computer to run the software etc. (no sound)

4. ***Public interaction: What form will the interaction with the public take? Will the piece be sturdy enough for visitors to interact with it on their own? Will we need support from the staff at Tetem for interaction with the work? Should we organise a few events prior to the opening to test the work with the public and collect data? Should we invite a local sports team and collect their movement data?***

Yes, I am planning to design the piece / straps in such a way that the audience can interact with it directly. The exhibition staff team might need to give some instructions, but I hope that it will be possible with the interface that we will use to make all instructions clear and have an autonomous interactive piece.

Regarding the workshops, here more details:

I would like to host two (or three) workshops / interventions prior to the exhibition and possibly use one for during the show.

There will be one workshop with an expert in kinesiology / human movement sciences. In this workshop we would make use of the tool (in its raw process state, if prior to opening), conduct different exercises and learn how human movement is interpreted within the field of Human Movement Sciences (what are indicators, how does a Human Movement Scientist look at human motion, what are methodologies, are there multiple, why etc.). in this workshop I'd also like to unfold a bit how motion capture technology has impacted the field of Human Motion Studies and what the various applications of this technology are currently – what new ones might emerge etc.

Finally this workshop will bring about one simple kinesiology exercise introduced by the human motion expert, which visitors later on can imitate / mirror with the DIY MoCap tool.

A second activity would be to arrange one Tai Chi class with a Tai Chi Master, learn about body knowledge and body science from this perspective and record a particular motion with the tool, which can again be imitated / mirrored in the exhibition by visitors. I find Tai Chi interesting here as its knowledge upon the human body might introduce some wider and alternative human body readings, which I feel would be relevant to the question of how human bodies are read by technologies and how to challenge universal thoughts here, such as ideas of universal body patterns, embedded within the technology. But if you have other suggestions here, I'd be happy to reconsider.

At last I want to use the fact that the DIY tool is mobile and could be used in any location, e.g. for public space interventions and data collecting. Here I was thinking to simply draw a path with chalk on the floor in a public space setting and ask people to walk along this path while wearing the motion straps – hence recording their gait. I should be able to control the tool with a laptop / tablet / smartphone, by logging into the web-socket

to receive and store the data. Maybe a small application can also directly visualise the tracked motion in real time, but this would be of secondary importance and is more relevant for the exhibition. The public space activity can also work without real time animation.

The publicly accumulated walk patterns / gaits would be the basis for the gait overlay which will also be shown and continuously constructed in the exhibition.

Public Interaction:
During the exhibition visitors will be able to choose from the 3 movements and decide to contribute with their own motion signature to one of the collective motion sculptures that we have started to build with the workshops.

5. ***Workshop(s): What kind of workshop can we do around this topic and this tool?***

   This would be the workshops as described above in point ***4. Public Interaction.***

6. **Development planning: Can you send us a schedule for the development and testing of the tool, leading up to the exhibition in February? With this schedule we can also think about when you would need to come back to the Netherlands to test, what you can do in London, etc.**

--> See next page.

04 | QUESTION

The Hackers Part: What level of coding / programming support can H&D provide?

Hans in Shenzhen is open to help out and directly communicate with e.g. Heerko. As I understood from Hans the steps to make it a full body motion capture tool are very clear. Also he had some good ideas about how to make it a mobile tool, which can also be used to record motions when being outside, e.g. in a public space intervention. Maybe it would be good if I could chat again with Heerko about all these details to understand what will be possible and what not.

MOVEMENT SIGNATURE
MOTION CAPTURE TOOL
HACKERS & DESIGNERS

Project Overview and Practicalities
Kiki Mager

now [OCTOBER]

Built Raw MoCap Tool

1. connect sensors in easy way to software / web-socket which will gather its data
2. figure out (with Hans) how to combine the different sensors (the missing sensors are in Rotterdam, a friend was able to take them from CN by plane, they are on their way to me in LDN for assembly —> I will keep some to built the straps etc and forward some to Heerko for the software development)
3. plug into Unreal Engine (or similar, I use Unreal usually) to animate skeleton live with the motion data
4. make sure this raw version can be used in a mobile setting via phone / tablet / laptop

Develop Visual Concept

for software interface and collective movement signature sculptures

1. figure out method of visualising overlays of motions (collective motions)
2. get detailed understanding of all numeric data that is generated by the sensors and construct a visual method to show this data or use it as a way to visualise the movements, don't hide this numeric representation of bodily movements
3. Check which software builder to use for this visual lanbguage (Unreal Engine with C4D models or other possibilities?)

NOVEMBER/DECEMBER/JANUARY

Public Interaction + 1st WS

1. test raw version of tool in public space and 1st workshop
2. accumulate first raw motion capture data with the tool
3. gain feedback / insights from public on further refienement of the tool + strap design

Continued Refinement
tech + visual

essentially using new data and insights from interactions to refine and finalise the motion capture tool in all its aspects (software, sensor sensitivities, data visualisation, mobile interaction, interface design, hardware design etc.)

--> develop final visual method of work and make first trial visualisations of *collective movement signature sculptures*.

FEBRUARY

Public Interaction

now in context of exhibition more data will be generated with the DIY tool, constantly adding / reshaping the collective motion sculptures

2nd Workshop

One more workshop to be held within the show around the MoCap tool (t.b.d.)

POST–SHOW

Final Work

generate final motion capture animations and still from all accumulated data as result / representation of the work on colelctive movement signatures.