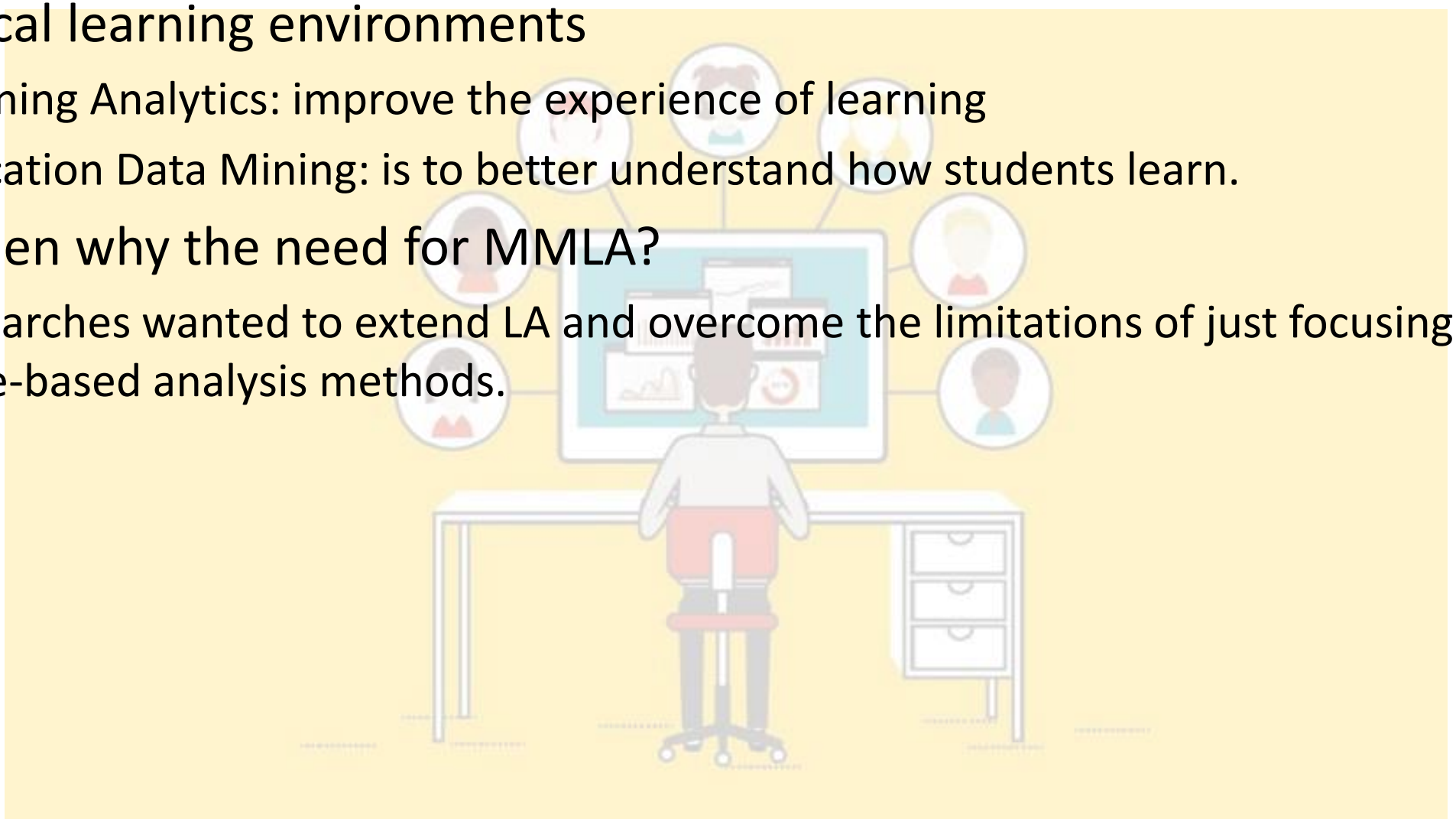
MMLA in non-classical learning environments

Submitted by: Imran, Hasan | Supervisor: Heinemann, Birte

LA and EDM

- Classical learning environments
  - Learning Analytics: improve the experience of learning
  - Education Data Mining: is to better understand how students learn.
- But then why the need for MMLA?
  - Researches wanted to extend LA and overcome the limitations of just focusing on digital trace-based analysis methods.



Multimodal Learning Analytics

- MMLA is a subfield of LA.
  - It focuses on different types of data from a variety of sensors and considers both the physical and digital environment.
- “MMLA is to study collaborative, real world, non-computer mediated environments.” [1]

Focus of Talk

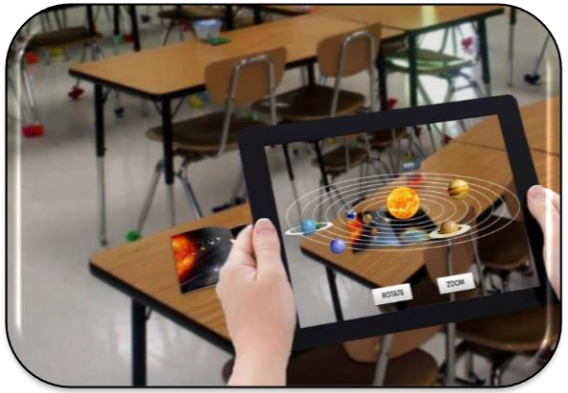
- Non-classical environments
- Sensors that are currently used
- Microsoft Kinect
- Multitouch tables

Non-classical learning environments

Multitouch tables

Multitouch games

Virtual reality



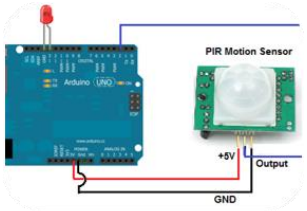
Augmented reality

Collecting data using Sensors

- Data collection:
  - Time-based
  - Activity-based
- Kinect

Eye tracker

Hand gestures



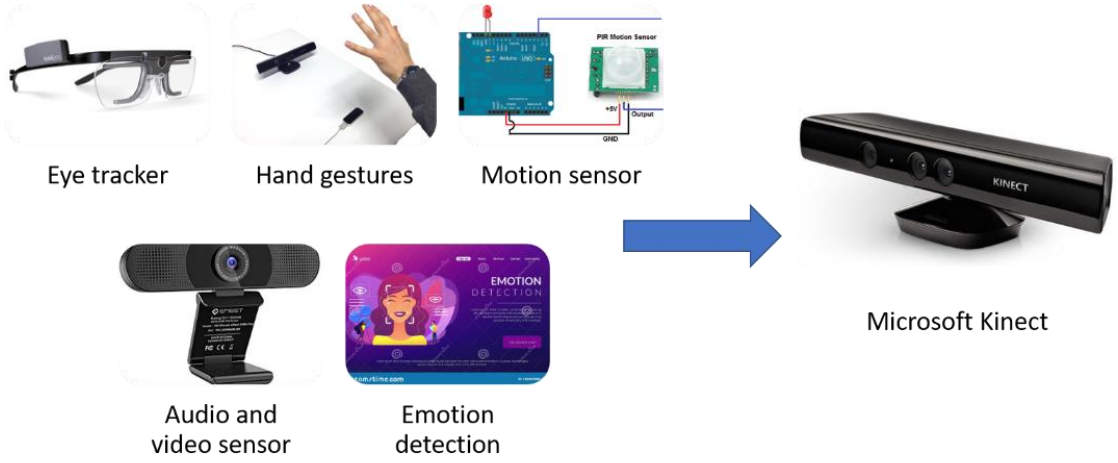
Motion sensor

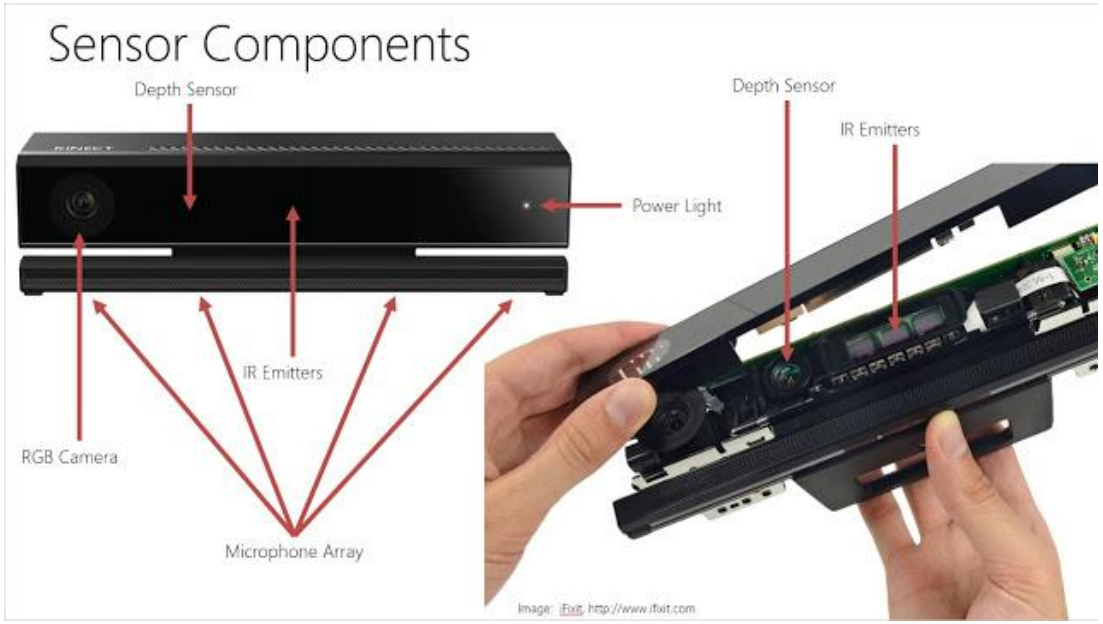
Audio and video sensor

Emotion detection

Microsoft Kinect

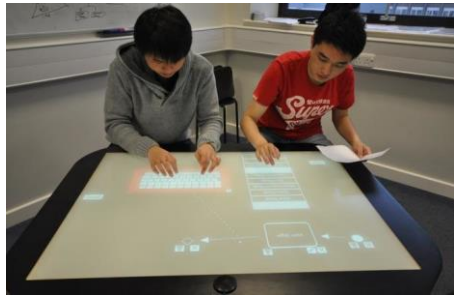
- The Microsoft Kinect sensor collects information about a person's:
  - body joints (x,y,z coordinates)
  - facial expressions
  - speech





Multi touch tables

- *“Multi-touch tabletop displays provide a co-located collaborative workspace for multiple users around a physical table. They sit together and perform collaborative interaction to select and manipulate digital contents using their bare fingers.”* [2]



- Computer-supported collaborative learning (CSCL) environments.
- “Multi touch tables allow to exploit the learning groups’ digital footprints” [3]

Using the Kinect in MMLA

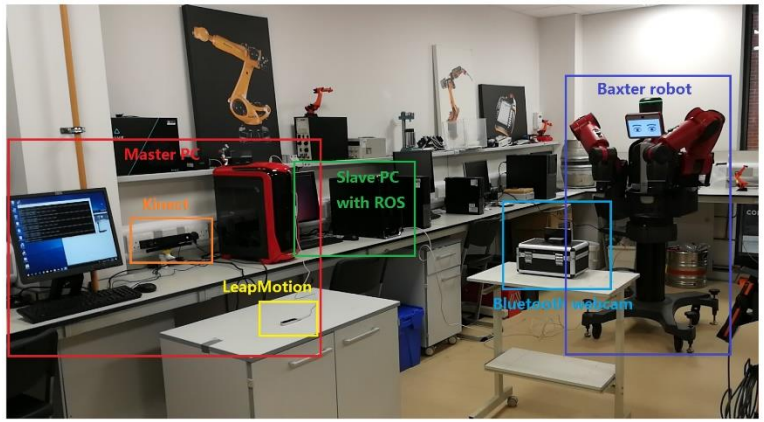
- captures audio and video
- motion sensing
- creating virtual educational environments.

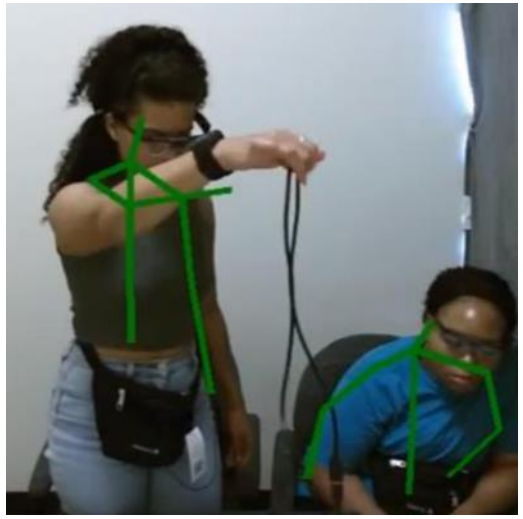
Projects done using the Kinect

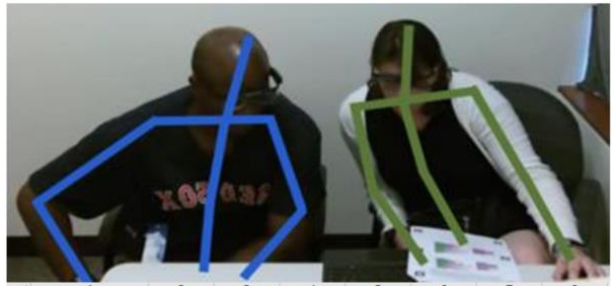
- Harvard LIT group has used Kinect for MMLA studies :
  - Augmented Electronic Sensing and Robotics
  - Kinect Learning Analytics

HARVARD UNIVERSITY

LIT Learning, Innovation and Technology Lab







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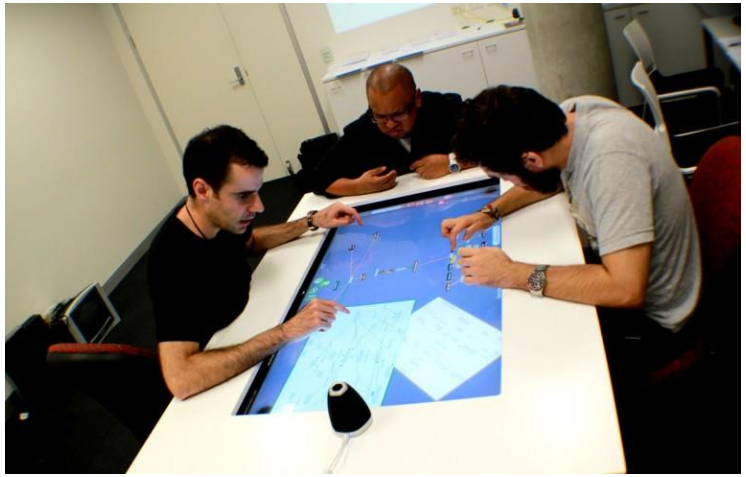
10	8/10/2017 2:21	3	8795	4986	0	-0.7346	-0.28766	1.409598

- Consider the possibility of using Kinect with CSCL devices

Multitouch tables in CSCL environments

- Multitouch tables can be used to study how people think, perform, and analyze in a group.
- Projects show that it is possible to capture multi-modal data about collaboration in a tabletop activity. [4]
- It is possible to deploy multi-touch technology in a classroom. [3]
- However, this leads to some interesting technical, educational and development challenges. [3]



Challenges encountered with multitouch tables

- Multitouch tables are no doubt a great way for understanding and researching group collaboration but they are limited by only being able to access direct human-tabletop interactions.
- The verbal and gestural interactions that learners have with each other cannot be captured with-out the use of external sensors. [5]

Challenges encountered with multitouch tables

- This is where the Kinect comes into play. It has the capabilities to:
  - capture multiple gestures at a time
  - recognize human interactions
  - can be configured to use face-detection
  - work in virtual environments as well.

Using the Kinect with Multitouch tables

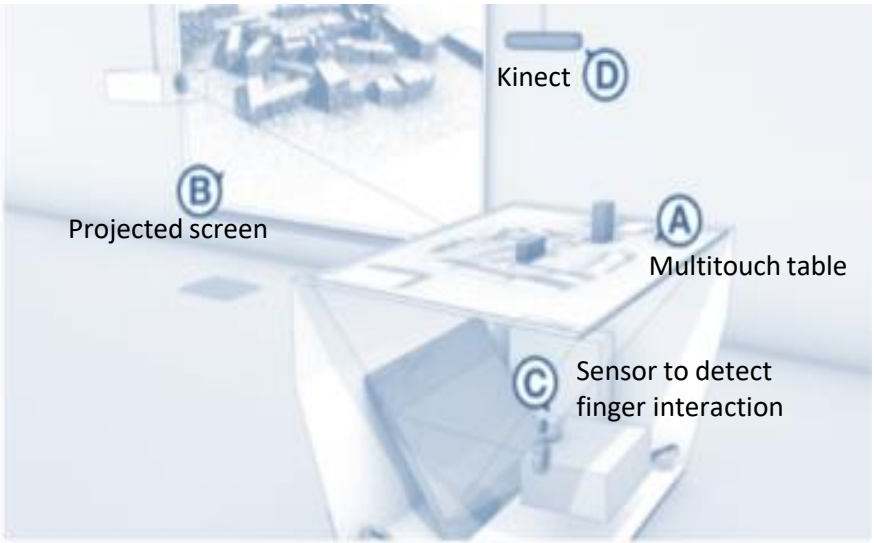
- [5] Adapting to support collaboration involves tackling several sub-problems:
  1. detecting when a group is struggling?
  2. determining when the system should provide feedback,
  3. what sort of support it should provide?
  4. and for how long.
- How the Kinect can solve these problems:
  1. Face detection → estimate that the group is struggling.
  2. Motion detection → see if the student request for help.
  3. Emotion detection → indicate that the problem is solved.

A proposed approach

- Connecting the Kinect sensor with the multitouch table.

Multitouch table

Microsoft Kinect



- The potential approach is taken from the research paper by Bratoev. [6]

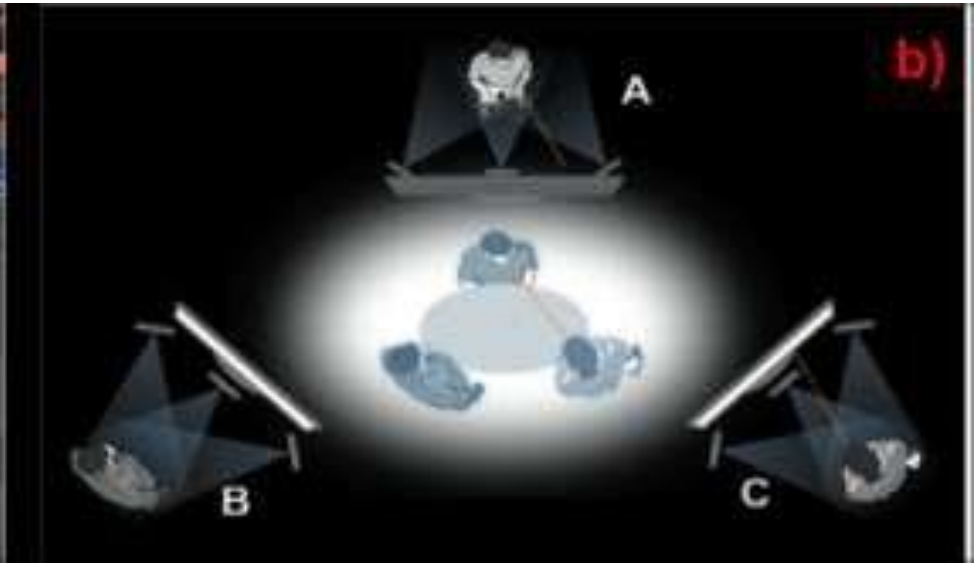
Collaboration in the virtual world using Kinect

- Study collaboration in virtual simulations.
- [7] Project body movements and gestures in virtual environments.
  - Example: virtual lecturing.
- Create hybrid spaces that allows users to engage in collaborative role-play through virtual avatar embodiment.
- Study, measure and observe learning in the VR environment.

Group collaboration in a virtual environment

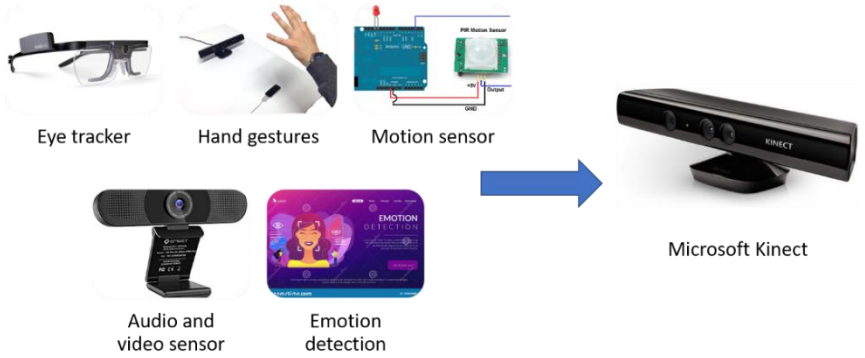
- Kinect simulated virtual environment

Kinect Avatar Project

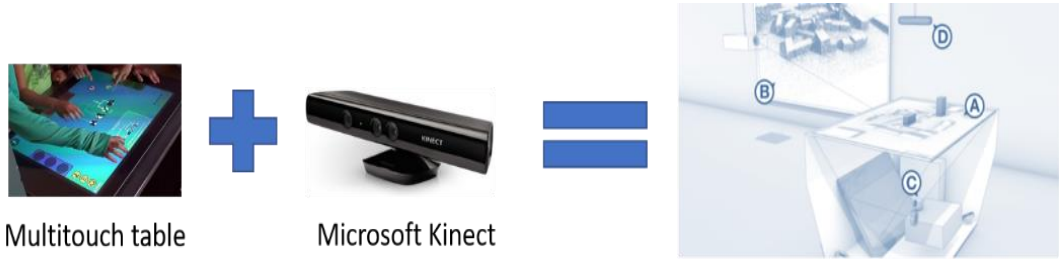


Immersive Telepresence meeting

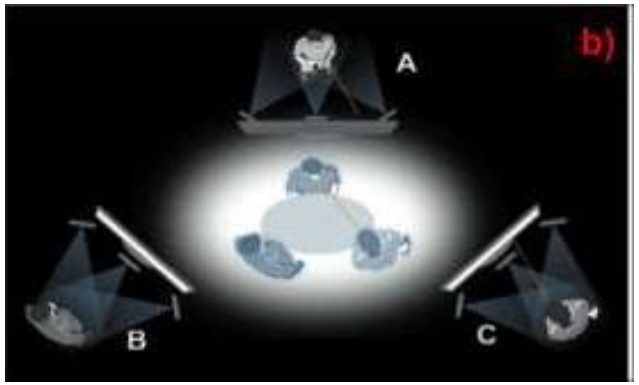
Conclusion



1. As a replacement for a variety of sensors



2. Used with a multitouch table to study collaboration

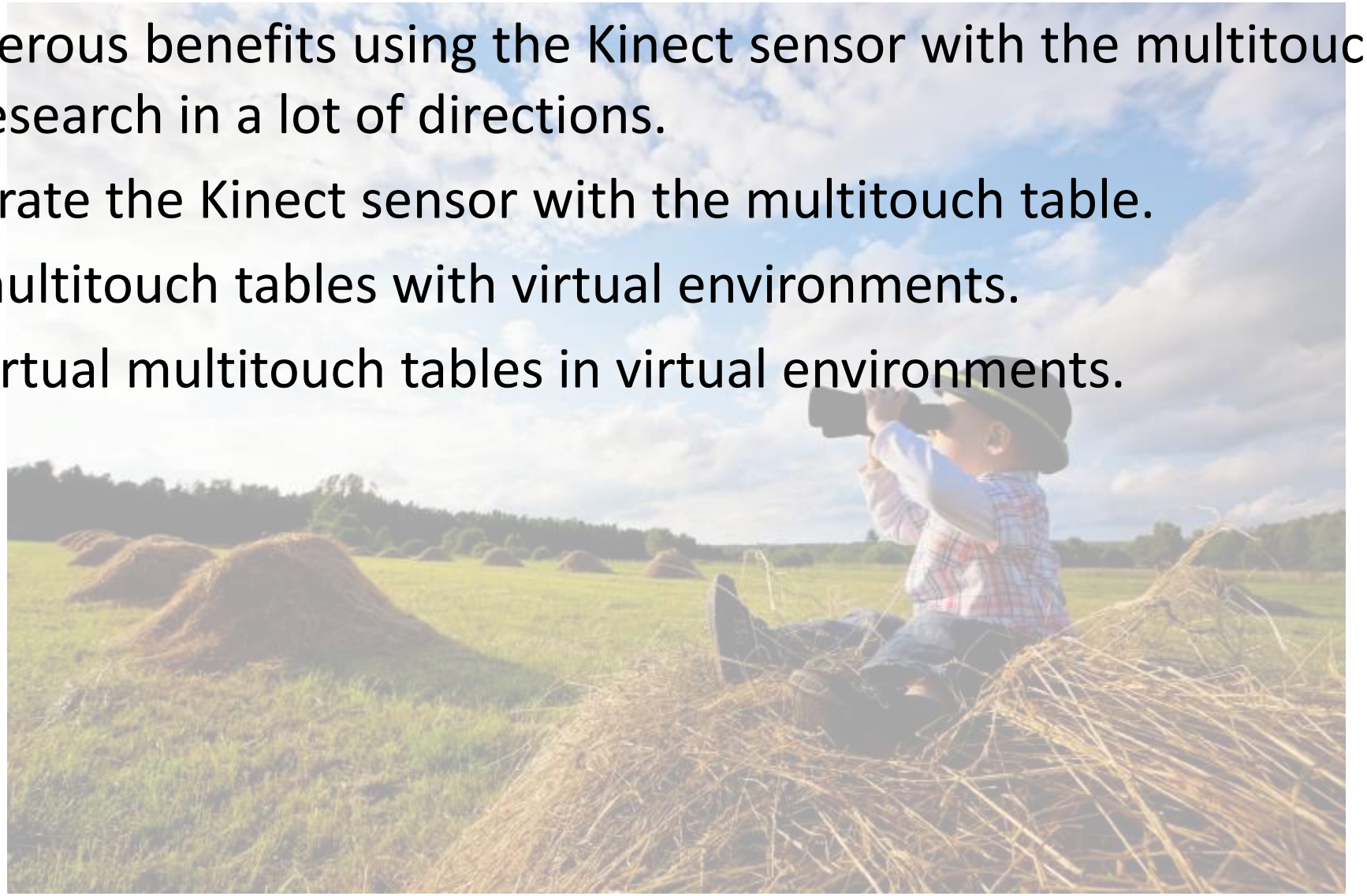


3. Used in virtual environments to study collaboration

Looking into the future

- The numerous benefits using the Kinect sensor with the multitouch table can enable research in a lot of directions.

1. Incorporate the Kinect sensor with the multitouch table.
2. Using multitouch tables with virtual environments.
3. Using virtual multitouch tables in virtual environments.



Summary

1	Kinect can be used as a replacement for all the most common sensors
2	The multitouch table can be combined with a Kinect sensor in replacement of the external sensors that are commonly used.
3	How to use the Kinect sensor with virtual environments is explained as well.

- Key words:
  - Learning Analytics | Education Data Mining | Multimodal Learning Analytics | Microsoft Kinect | Multitouch tables | Collaboration | Virtual Environments

Discussion – Q/A

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Figures and Pictures references

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MMLA in classical learning environments

- Once the data is gathered, all that remains is to apply the various LA and EDM techniques to interpret results from the data. Either we want to cluster our results or classify them based on the type of sensor data. We can then derive interpretations from our analysis and improve the learning process.