Position Sensing and Imitation
Intermediate Presentation

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Reminder: Goal Statement

- **Goal:** Mimic position and motion of a plate

- **Sensing:** 3D MEMS attitude sensor embedded in a plate
- **Communicating:** Implement industrial bus
- **Actuating:** Rotate a plate using motors

Reminder: Functional Overview

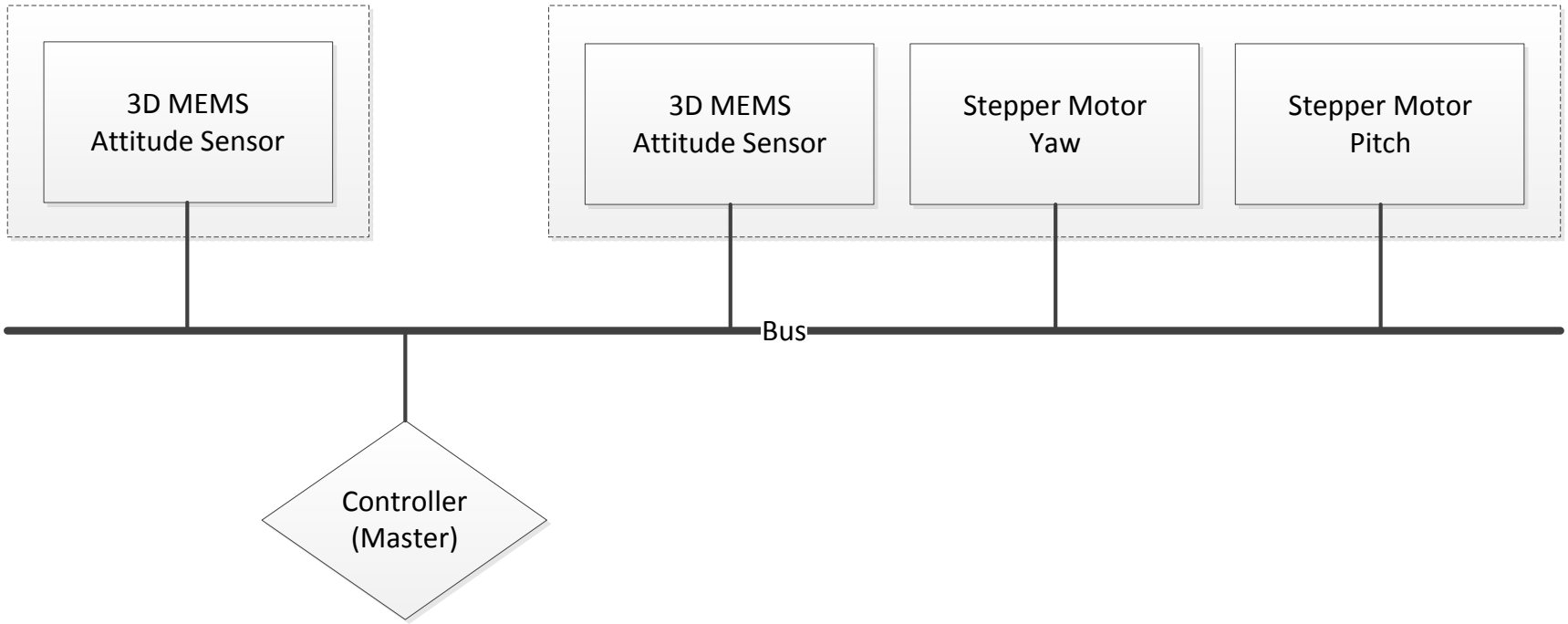

Figure : Diagram of the Functional Specification

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Reminder: Major Milestones

- **Sensing:** Read and process MEMS data
- **Actuation:** Control stepper motors
- **Mechanics:** Construct movable plate
- **Communication:** Implement industrial bus
- **Controller:** Bus master, main computational unit

Milestone: Sensing

Read and process MEMS data

Status:

- Reading data via I2C works
- Computing plate position from data works
- Additional filtering might be required

Milestone: Actuation

Control stepper motors

Status:

- Communication with stepper drivers via SPI works
- Control of stepper motors works
- Additional work on control daemon necessary

Milestone: Mechanics

Construct movable plate

Status:

- First version of plate construction printed
- Works for now
- Design on second, refined version in progress

Milestone: Communication

Implement industrial bus

Status:

- A lot of research was done
- EtherCAT selected as most interesting
- CAN selected as fallback
- Work in progress

Milestone: Controller

Bus master, main computational unit

Status:

- Modular design to fit CAN and EtherCAT
- High-level controller class
  - Receives periodic sensor input events
  - Computes angle corrections for all drives
- CAN or EtherCAT wrapped into classes to provide the events and send corrections
- Built on a BeagleBone Black

Timing

Timing goal: Move plate to desired position within 1 second

Fixed timings:

- Sensors
  - Sample every 10 ms
  - Report mean value every 100 ms
- Actuation takes up to 500 ms

Delay constraint: 500 ms to compute & communicate

Node Description

Node Name	ID / Priority	Master / Slave
Controller	1	Master
Source Sensor	2	Slave
Target Sensor	3	Slave
Stepper Driver	4	Slave

Table : Nodes in the network

EtherCAT

Bus Option 1

- Required cycle time: 100 ms
- Slave: TI AM3359 ICE board with TI EtherCAT Slave stack
- Master: BeagleBone Black with IgH EtherCAT master runtime
- Master app.: Update Controller on each cycle
- Achievable cycle time using the generic NIC driver still unclear

CAN

Bus Option 2

- Required cycle time: 100 ms
- All nodes are BeagleBone Blacks
- CAN controller: ???
- Sensor values are periodically fed to the Controller from a buffer
- Possibly with a communication scheme like TTCAN

Message Description

Bus Option 2

Description	Data Request	Length
Sensor Position	Allowed	6 Bytes
Motor Status	Allowed	4 Bytes
Rotation Command	Not Allowed	3 Bytes
Reset Command	Not Allowed	3 Bytes

Table : Possible messages in the network

Future work

- Implement bus communication
- Finish master controller
- Tune motor timings
- Refine plate construction

Thanks for your attention!

Questions? Ideas? Suggestions?