KPIT

Summer 2019

Sensor Fusion: Ultrasonic Sensor

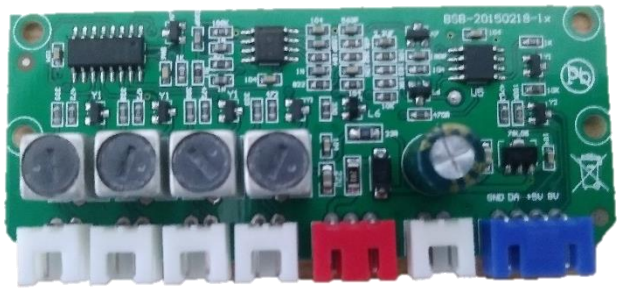
PGA460 and Murata MA58MF14-7N

Presenter: My Uyen Nguyen, MIT

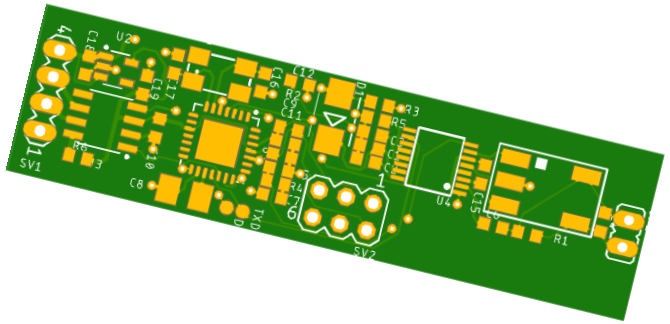
Mentor: Ankur Deo

Related Works

On Vehicle



Developed Embedded Platform



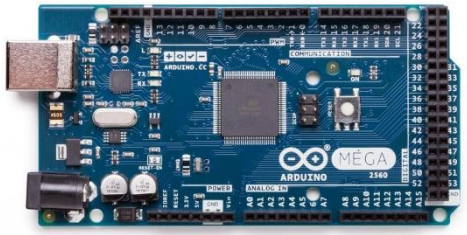
Product specs

- 4 ultrasonic sensors
- Up to 2 meters
- 4 frames per second

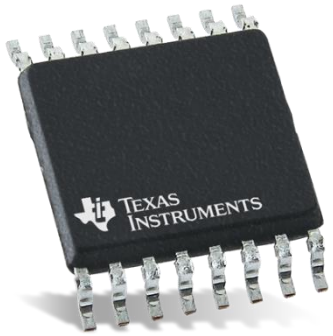
- 1 ultrasonic sensor
- Unknown distance range
- Unknown feed rate

Project Objectives

- Accurate and consistent distance measurement of up to 2 meters
- Feed rate of >= 10 frames per second
- Multiple sensors configuration using 1 microcontroller



Microcontroller

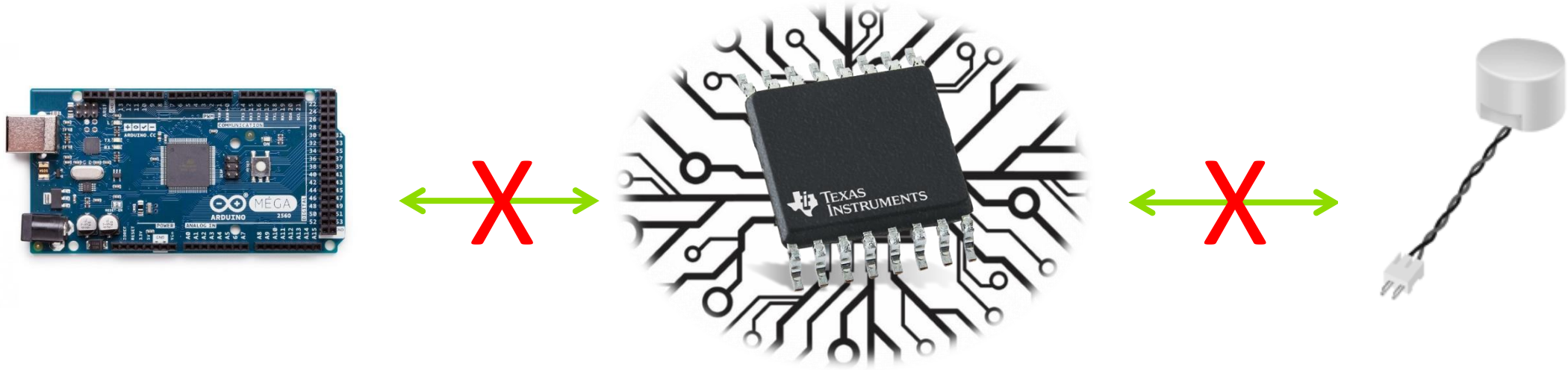


Ultrasonic Driver

Ultrasonic sensor

Challenges and Troubleshooting

- Unreliable hardware and software
- Failed serial communication and burst+listen
  - → Constant distance measurement regardless of object detection
  - → Invalid data transmission
- Incomplete understanding of ultrasonic driver's method of operation



Microcontroller Ultrasonic Driver Ultrasonic sensor

Method of Operation

INITIALIZATION – EEPROM, Threshold, AFEGAIN + TVG

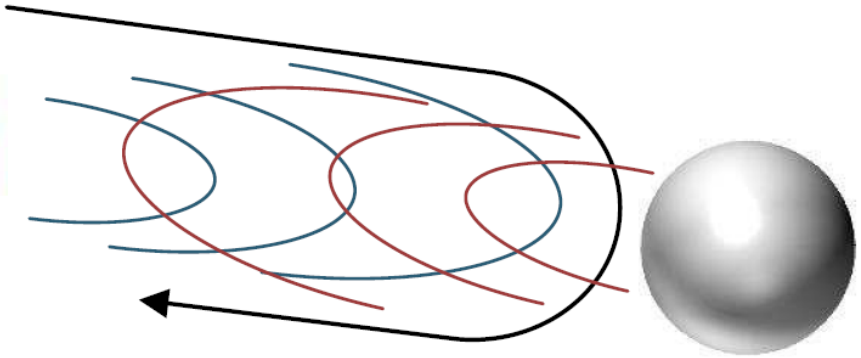
BURST + LISTEN

PULL + FILTER DATA

COMPUTE DISTANCE

Loop

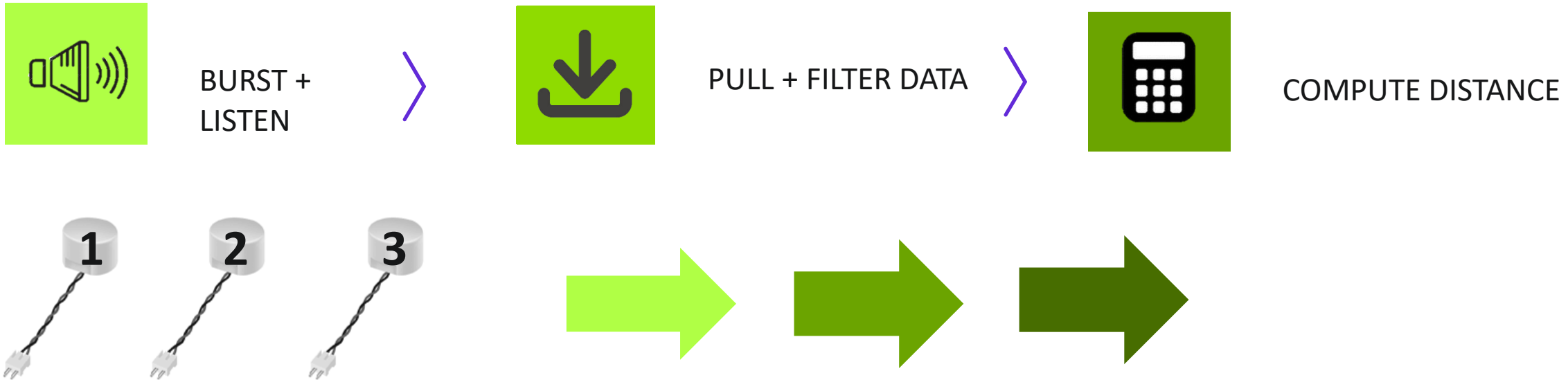
XDCR TX+RX



Mono-Static Configuration

Modified Method of Operation

- Additional Methods of Data Communication
  - USB Communication for PC
  - CAN Bus for ECUs

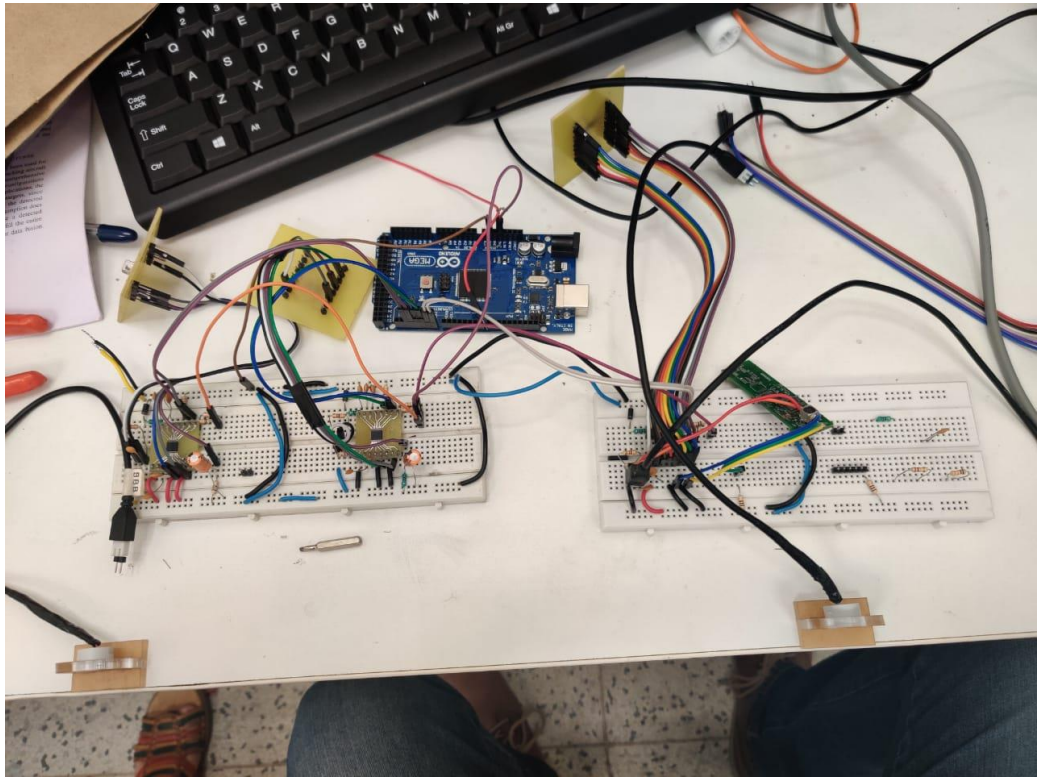


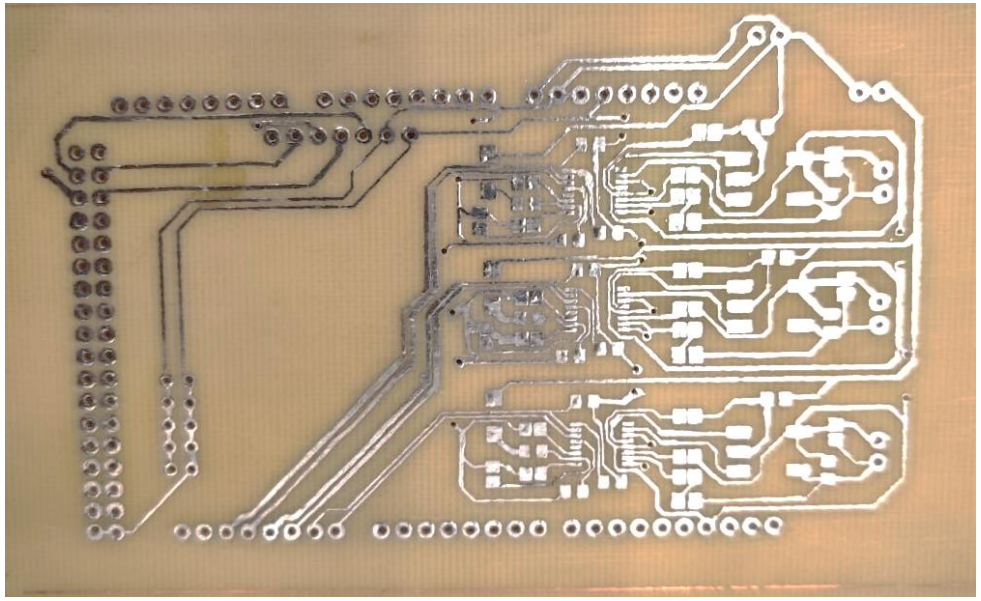
Results

Performance Comparison

	Third-Party Device	Inherited Device	Developed Embedded System		
Number of sensors	**4**	1	1	2	**3**
Min distance (m)	**N/A**	N/A	0.25	0.25	**0.25**
Max distance (m)	**2.0**	N/A	3.5	3.5	**3.5**
Frames per second	**4**	N/A	45-50	44	**43**
Accuracy	N/A	N/A	+/- .02	+/- .02	**+/- .02**

Product Reveal





Future Works

- Manufacture PCB for multiple-sensors setup (IN PROGRESS)
- Test PCB outside of lab and confirm maximum distance range
- Install sensors onto vehicle for real-time testing
- Increase number of ultrasonic sensors driven by one microcontroller using SoftwareSerial

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Thank you for a wonderful time at KPIT and in India

Special thanks to Ankur Deo and Sant Ranjan