Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Team 28: Gas Monitoring System
Bi-Weekly Update 4

Matthew Owen, Joaquin Salas, Blake Schwartzkopf, Tanmay Sarkar

Sponsor: Global Hawk Solutions LLC (Justin Houck)

TA: Vishwam Raval

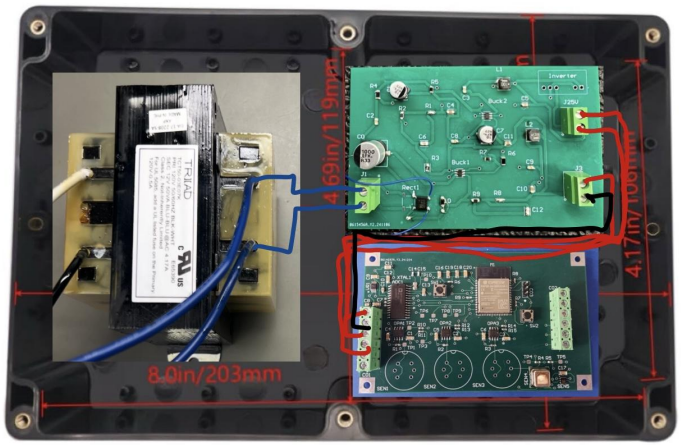
Project Summary

- Monitoring environmental conditions in animal farms.
- To design and implement a durable, real-time gas monitoring system that can track harmful gases in animal farms.

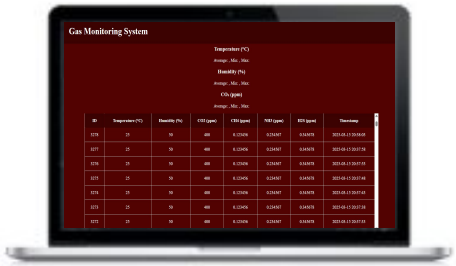
Integrated System Diagram

AWS IoT

Gas Monitor



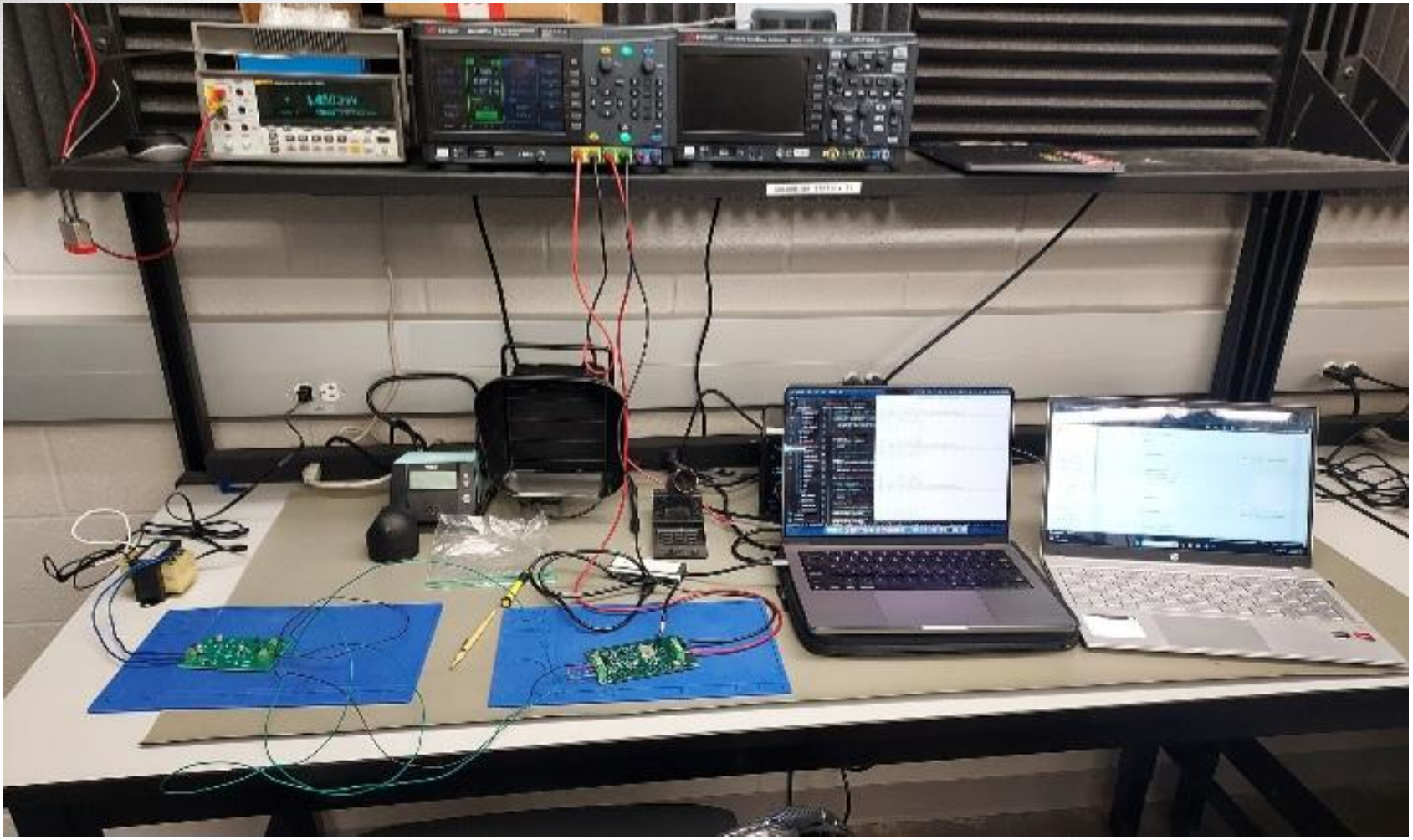
User Interface



Database

Web Server uses Database to populate graphs and view historical data

Integrated System Diagram



Project Timeline

Troubleshoot/ Debug Individual Subsystems (completed 1/27)	Integration of Power and Sensor Subsystems (to complete by 2/14)	Integration of MCU and Database (to complete by 3/3)	Integration of MCU and Sensor Subsystems (to complete by 3/3)	Complete Integration (to complete by 3/17)	Testing / Validation, Housing unit completed (to complete by 3/31)	Demo and Report and Engineering Showcase (to complete by 4/7)

Matthew

Accomplishments since last update 13 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Resoldered new parts onto PCB board - Fixed inverter circuit - Integration with sensor subsystem fully completed - Full system integration testing	- Enclosure is ordered and will work on modifying it and mounting PCBs/Transformer - Working on any integration errors that arise

Blake

Accomplishments since last update 12 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Correcting error in ADC readings by linearizing data - Full integration with microcontroller subsystem - Full integration tests with all subsystems	- Ensure analog sensors can run for long periods of time (sizzling sound) - Write code for adc value to parts per million conversion - Continue tests with other subsystems - Collecting data on farm

Sensor + MCU Integration

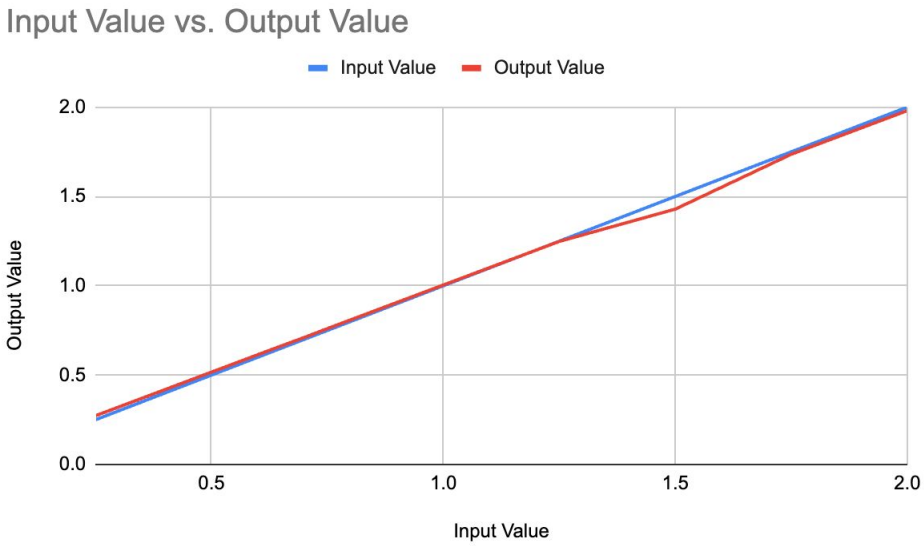
Analog Input before and after being corrected - Joaquin and Blake (02/27/25)

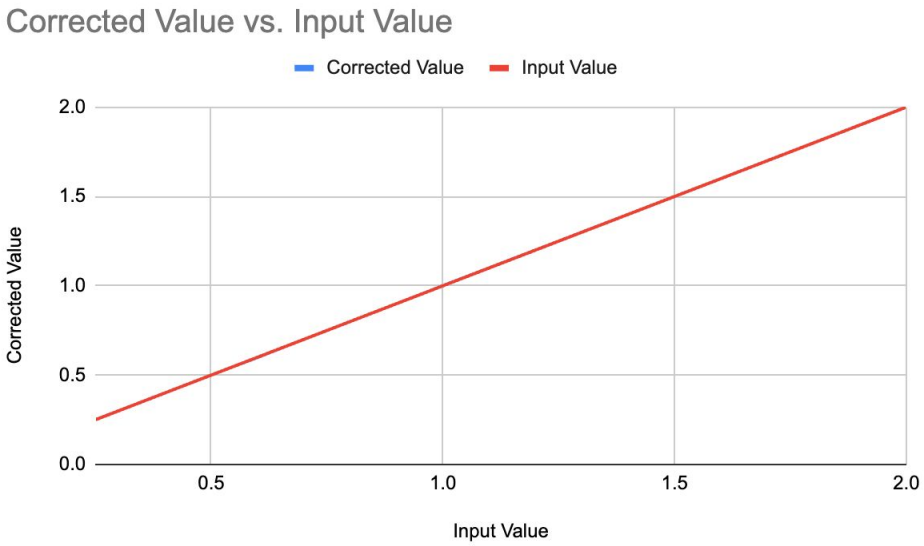
Input Value	Output Value	Corrected Value	Error (%)
0.25	0.272611	0.24996	0.00016
0.3	0.3214	0.299959	0.00014
0.35	0.370206	0.349975	0.00007
0.4	0.419002	0.399982	0.00005
0.45	0.467812	0.450002	0.00000
0.5	0.516805	0.500005	0.00001
0.55	0.565394	0.550004	0.00001
0.6	0.614412	0.599039	0.00160
0.65	0.6629	0.649928	0.00011
0.7	0.710648	0.699913	0.00012
0.75	0.760481	0.749993	0.00001
0.85	0.858065	0.849934	0.00008
0.95	0.955856	0.949924	0.00008
1	1.00447	1.00046	0.00046
1.25	1.24846	1.250016	0.00001
1.5	1.429238	1.499936	0.00004
1.75	1.736281	1.749929	0.00004
2	1.980254	1.999953	0.00002

Sensor + MCU Integration

Linearizing Data for ADC - Joaquin, Blake (02/27/25)

- **Data more accurate at all input voltage levels**





Joaquin

Accomplishments since last update 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Completed integration with Blake - Improved Error/Initializing handling - Maintained stable Wi-Fi connection through lab time, with occasional successful reconnection (3 hours) - Full integration tests with all subsystems	- Wi-Fi Provisioning - Create user manual/start-up instructions for our sponsor - Convert adc value to parts per million

Sensor + MCU Integration

Wi-Fi timeout caused from weak signal, busy network, etc.

Reconnects to network and re-initializes connection to AWS

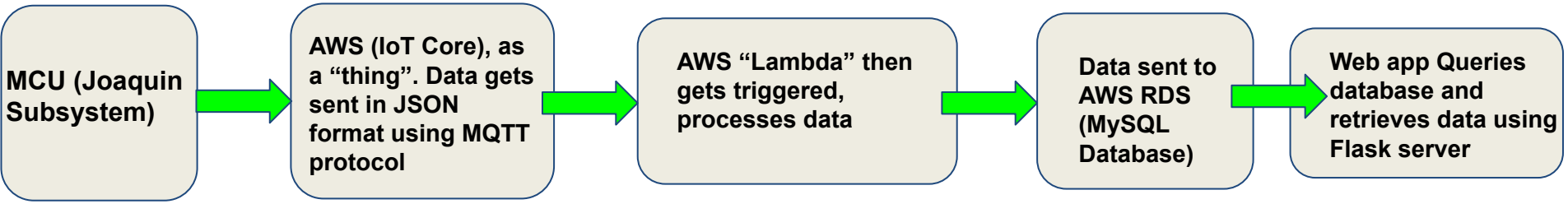
Sponsor visited Thursday, March 6th.

Very happy with progress, wants to add Wi-Fi provisioning and a start-up manual

```
E (134056) esp-tls-mbedtls: write error :-0x004E:
E (134056) coreMQTT: sendMessageVector: Unable to send packet: Network Error.
E (134066) coreMQTT: MQTT PUBLISH failed with status MQTTSendFailed.
E (134076) gasmonitor: MQTT_Publish error: 3. Reconnecting...
E (134076) esp-tls-mbedtls: write error :-0x004E:
E (134086) coreMQTT: sendBuffer: Unable to send packet: Network Error.
E (134096) coreMQTT: Transport send failed for DISCONNECT packet.
I (134256) wifi:<ba-add>idx:0 (ifx:0, 54:d7:e3:ab:d6:e2), tid:6, ssn:1, winSize:64
W (134256) wifi:[ADDBA]rx delba, code:39, delete tid:6
I (134256) wifi:<ba-del>idx:0, tid:6
W (134256) wifi:[ADDBA]rx delba, code:39, delete tid:6
I (135266) wifi:<ba-add>idx:0 (ifx:0, 54:d7:e3:ab:d6:e2), tid:6, ssn:1, winSize:64
I (135266) wifi:<ba-del>idx:0, tid:6
I (135276) wifi:<ba-add>idx:0 (ifx:0, 54:d7:e3:ab:d6:e2), tid:6, ssn:1, winSize:64
I (135276) wifi:<ba-del>idx:0, tid:6
I (135276) wifi:<ba-add>idx:0 (ifx:0, 54:d7:e3:ab:d6:e2), tid:6, ssn:1, winSize:64
I (135946) wifi:<ba-add>idx:1 (ifx:0, 54:d7:e3:ab:d6:e2), tid:7, ssn:0, winSize:64
W (135946) wifi:[ADDBA]rx delba, code:39, delete tid:7
I (135946) wifi:<ba-del>idx:1, tid:7
W (135946) wifi:[ADDBA]rx delba, code:39, delete tid:7
I (136236) wifi:<ba-add>idx:1 (ifx:0, 54:d7:e3:ab:d6:e2), tid:7, ssn:0, winSize:64
I (136246) wifi:<ba-del>idx:1, tid:7
I (136246) wifi:<ba-add>idx:1 (ifx:0, 54:d7:e3:ab:d6:e2), tid:7, ssn:0, winSize:64
I (136736) esp_netif_handlers: sta ip: 10.251.158.67, mask: 255.254.0.0, gw: 10.250.0.1
I (136736) wifi: Got IP: 10.251.158.67
I (137636) wifi:<ba-del>idx:0, tid:6
I (137646) wifi:<ba-add>idx:0 (ifx:0, 54:d7:e3:ab:d6:e2), tid:0, ssn:0, winSize:64
W (137646) wifi:[ADDBA]rx delba, code:39, delete tid:0
I (137646) wifi:<ba-del>idx:0, tid:0
W (137646) wifi:[ADDBA]rx delba, code:39, delete tid:0
I (137836) wifi:<ba-add>idx:0 (ifx:0, 54:d7:e3:ab:d6:e2), tid:0, ssn:1, winSize:64
W (137836) wifi:[ADDBA]rx delba, code:39, delete tid:0
I (137836) wifi:<ba-del>idx:0, tid:0
W (137846) wifi:[ADDBA]rx delba, code:39, delete tid:0
I (137926) wifi:<ba-add>idx:0 (ifx:0, 54:d7:e3:ab:d6:e2), tid:0, ssn:2, winSize:64
I (137936) wifi:<ba-del>idx:0, tid:0
I (137936) wifi:<ba-add>idx:0 (ifx:0, 54:d7:e3:ab:d6:e2), tid:0, ssn:2, winSize:64
I (139296) AD7718: AIN1 Voltage: 0.999462 V
I (139496) AD7718: AIN2 Voltage: 0.500767 V
I (139626) gasmonitor: TLS connection successful
I (139696) AD7718: AIN3 Voltage: 0.000782 V
I (140296) coreMQTT: MQTT connection established with the broker.
I (140296) gasmonitor: MQTT connection successful
I (140796) gasmonitor: mqtt_process_task started
I (140956) gasmonitor: Publishing: {"temperature":24.46, "humidity":26.25, "co2":481.00,
 "AIN1":0.999462, "AIN2":0.500767, "AIN3":0.000782}
I (144896) AD7718: AIN1 Voltage: 0.999431 V
I (145096) AD7718: AIN2 Voltage: 0.500768 V
I (145296) AD7718: AIN3 Voltage: 0.000786 V
```

Tanmay Sarkar

Accomplishments since last update 14 hours of effort	Ongoing progress/problems and plans until the next presentation
Full flow of data is now correctly working. Had to keep updating database + web app code as we added and tested more and more sensors	Plans for testing: Ensure that system stays online for extended period of time. (Ideally 24/7) Ensure that real data can be sent as JSON format changes If errors come up, go sensor by sensor to see what is messing up the dataflow.



Microcontroller-Database Integration

Publish

AWS

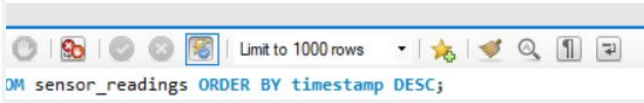
▼ sensor/reading — March 15, 2025, 15:38:03 (UTC-0500)


```
{
  "temperature": 25.00,
  "humidity": 50.00,
  "CO2": 400.00,
  "NH3": 0.123456,
  "CH4": 0.234567,
  "H2S": 0.345678
}
```


▶ Properties

▼ sensor/reading — March 15, 2025, 15:37:58 (UTC-0500)


```
{
  "temperature": 25.00,
  "humidity": 50.00,
  "CO2": 400.00,
  "NH3": 0.123456,
```

MySQL Database

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Ce

id	timestamp	temperature	humidity	CO2	NH3	CH4	H2S
3279	2025-03-15 20:38:08	25	50	400	0.123456	0.234567	0.345678
3278	2025-03-15 20:38:03	25	50	400	0.123456	0.234567	0.345678
3277	2025-03-15 20:37:58	25	50	400	0.123456	0.234567	0.345678
3276	2025-03-15 20:37:53	25	50	400	0.123456	0.234567	0.345678
3275	2025-03-15 20:37:48	25	50	400	0.123456	0.234567	0.345678
3274	2025-03-15 20:37:43	25	50	400	0.123456	0.234567	0.345678
3273	2025-03-15 20:37:38	25	50	400	0.123456	0.234567	0.345678
3272	2025-03-15 20:37:33	25	50	400	0.123456	0.234567	0.345678
3271	2025-03-15 20:37:28	25	50	400	0.123456	0.234567	0.345678

Web App

Gas Monitoring System

Temperature (°C)

Average: , Min: , Max:

Humidity (%)

Average: , Min: , Max:

CO_2 (ppm)

Average: , Min: , Max:

ID	Temperature (°C)	Humidity (%)	CO2 (ppm)	CH4 (ppm)	NH3 (ppm)	H2S (ppm)	Timestamp
3278	25	50	400	0.123456	0.234567	0.345678	2025-03-15 20:38:03
3277	25	50	400	0.123456	0.234567	0.345678	2025-03-15 20:37:58
3276	25	50	400	0.123456	0.234567	0.345678	2025-03-15 20:37:53
3275	25	50	400	0.123456	0.234567	0.345678	2025-03-15 20:37:48
3274	25	50	400	0.123456	0.234567	0.345678	2025-03-15 20:37:43
3273	25	50	400	0.123456	0.234567	0.345678	2025-03-15 20:37:38
3272	25	50	400	0.123456	0.234567	0.345678	2025-03-15 20:37:33

Execution Plan

	1/13/25	1/20/25	1/27/25	2/03/25	2/10/25	2/17/25	2/24/25	3/03/25	3/10/25	3/17/25	3/24/25	3/31/25	Key
Solder New Sensor PCB													Sensor
Revalidate Sensor Subsystem													Power
Integrate Power and Sensor Subsystems													Microntroller
													Database
Fix inverted voltage													Group
Fix load voltage issues													Completed
Integrate Power and Sensor Subsystems													In Progress
Design Housing Unit													Not Started
Integrate MCU and Database													Behind Schedule
I2C Integration w/ MCU													
Analog Sensor Integration w/ MCU													
Test MCU according to Validation Plan													
Add security measures to database													
Integrate MCU and Database													
Debugging MCU w/ Database													
Validating MCU w/ Database													
Total Integration													
Housing Unit, final touches													
Full-system Validation													
Final Presentation	April 9th												
Final Demo	April 21st												
Final Report	April 28th												

Validation

Make database/web app more secure	Password/2FA security		Tanmay
Integrate MCU w/ database	Successful data transmission < 5 seconds		Tanmay
Deploy web application	Web application stays online 24/7		Tanmay
Read Analog Sensor Data	Successfully convert analog data through the ADC by testing different voltage inputs.	YES	Joaquin
Read Digital Sensor Data	Successfully collect accurate and consistent data from I2C sensors.	YES	Joaquin
Transmit Sensor Data	Transmit sensor data wirelessly over a Wi-Fi network to AWS.	YES	Joaquin
Wi-Fi Range and Stability	Maintain stable transmission over extended time periods (30 min, 1 hr, 2 hrs, 3 hrs)	YES	Joaquin
I2C Communications	Code can read CO2 and temperature/humidity sensor.	YES	Blake
SPI Communications	Code can read analog input from analog to digital converter.	YES	Blake
Microcontroller Flash	Microcontroller can upload code.	YES	Blake
Voltage Divider and Op Amp	Voltage divider cuts voltage in half. Unity gain op amp does not change the voltage. Works from range of .25 - 5V.		Blake
Correct Output Voltages	Specified voltages of 5,-5,3.3 V are supplied	YES	Matthew
Load Requirements Met	Power subsystem can adequately provides 0.5-1A of current	YES	Matthew
Entire project is safely housed	Successfully designed a housing unit that will protect the sensors, pcbs, transformers.		Matthew

Thank you !