From Manual to Automated: MECCSCARA in Modern Assembly
Selective Compliance Assembly Robot Arm (SCARA)

Jianhao Lin, Iriona Gravley, Dominic Silva, Foufouo M. Flora

1st Year Engineering Design: ENGR-113-061

Professor Juan De La Fuente, Vince Cariello

DREXEL UNIVERSITY
COLLEGE OF
ENGINEERING

IDENTIFIED PROBLEM

Manufacturing sectors increasingly struggle to balance quality, cost, and throughput in repetitive assembly tasks. While human labor introduces error-prone variability in precision operations, traditional industrial robots often are too expensive, inflexible and over-engineered for such production. Meanwhile, they have escalating market demands challenges, forcing manufacturers into unsustainable compromises. This growing automation gap leaves companies trapped between the limitations of manual processes and impractical robotic solutions, ultimately stifling productivity and competitiveness in an accelerating industry landscape.

IMPORTANCE

While the immediate demand might not seem critical, delay a more accurate automation in assembly manufacturing might lead to:

- ✓**High defect rates** – Human error in tiny component assembly compromises quality
- ✓**Production Bottlenecks** – Manual process slow throughput, creating supply chain delays
- ✓**Rising Labor costs** – Dependence on skilled workers drives up expenses, inflating product prices

MARKET AND MARKET NEEDS

TARGET MARKET

- **Electronics Manufacturing** – micro motor assembly, circuit assembly, SMT (Surface Mount Technology) component placement
- **Automotive and automotive electronics** – sensor and dashboard component assembly.
- **Medical device production** – syringe assembly, surgical instrument packaging

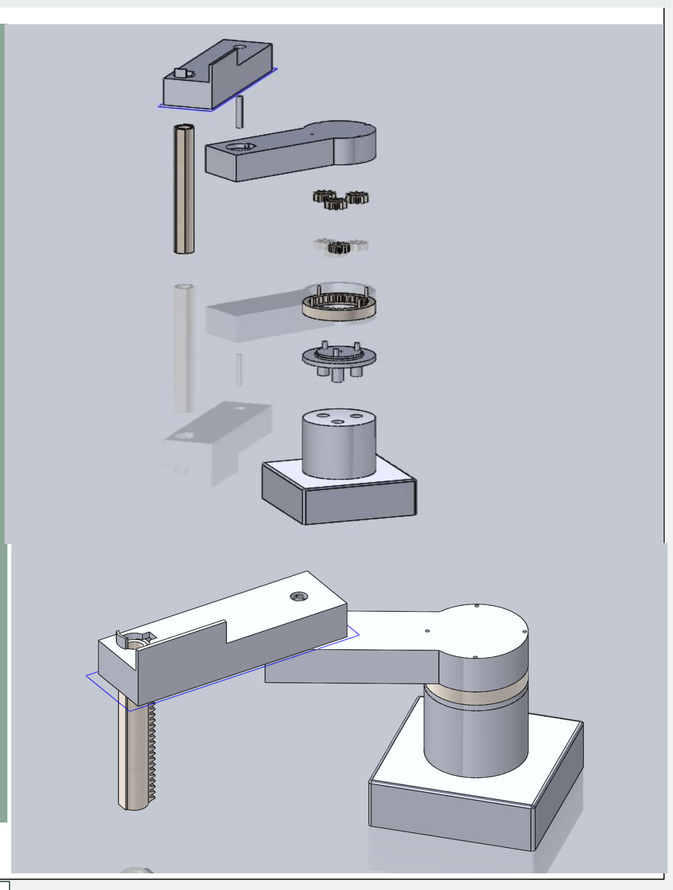
NEEDS

- **Error free precision** for delicate assemblies
- **Consistent High-Speed Operation,** eliminating bottlenecks
- **Long-Term cost saving** by reducing labor dependency

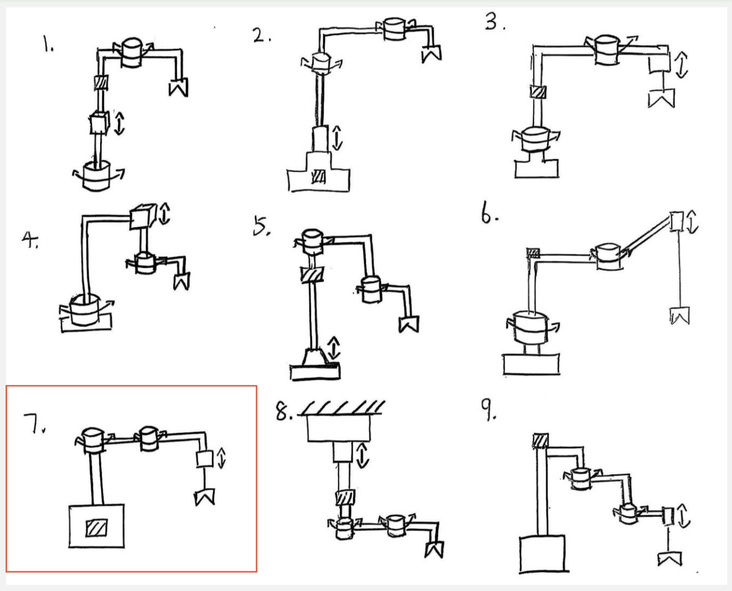
FINAL PRODUCT

FEATURES

- ✓**High Speed Operation** – 10 revolutions per minute, 2048 steps per revolution
- ✓**Stabilized end effector**
- ✓**Space efficient** – 5 inch wide and 12 inch long
- ✓**Intergrated motion control**
- ✓**Environmentally friendly** – produces no noise and uses biodegradable material for its body
- ✓**High precision** – moves in millimeter steps
- ✓**Easy maintenance** – product can be easily assembled and dismantled



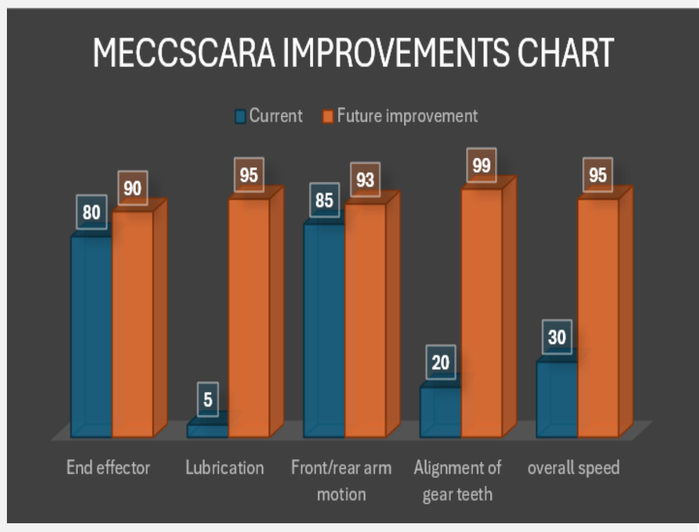
CONCEPT DEVELOPMENT



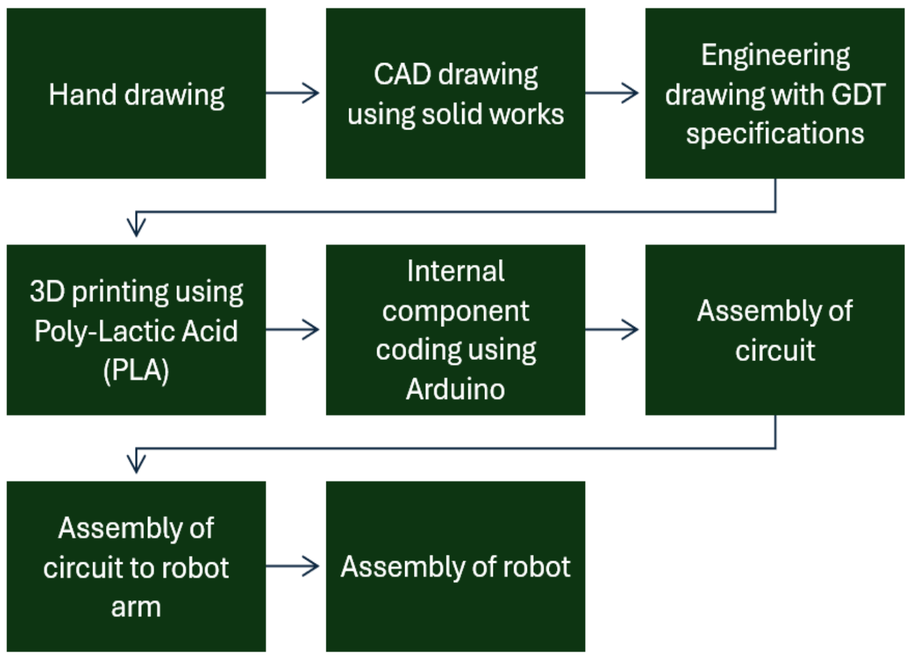
FUNCTION	SOLUTIONS		
Power	USB	Battery	
Move joint	Servo Motor	Stepper Mottor	
Z motion	Lead Screw	Rack and Pinion	Linear Actuator
End Effector	Finger Gripper	Vaccum Gripper	
User Interface	Serial Monitor	key pad	Web Interface (buetooth)
Control Logic	typed input	hard written program	button sequence
Home Position	Limit Switch	Gyroscope	

RESULTS

- ✓**End Effector Stability**
  - Demonstrated consistent grip and place accuracy under tested speed
- ✓**Rotary Joint Performance**
  - Front and rear arm achieved smooth motion at about 80% of targeted speed
- ✓**Critical Challenge Planetary gear friction**
  - Persistent blockage in base planetary gear system reducing the overall speed of the robot by 70%
    - Caused by little lubrication and misalignment of gear teeth



MANUFACTURABILITY



CONCLUSION

The MECCSCARA Robot is design to resolve the current need for an improvement in the assembly process of most production companies. The results show the MECCSCARA Robot delivers a solution for industrial assembly challenges, demonstrating reliable pick-and-place accuracy with 24/7 operational capability. While current planetary gear friction limits the speed, identified upgrades are projected to achieve 95% of target performance. Looking ahead, we are developing a mobile industrial variant and battery-powered operation to eliminate workspace constraints. This evolution from precision static automation to flexible mobile solutions positions MECCSCARA as both a near-term productivity booster and a future-proof investment, capable of reducing labor costs by up to 40% while adapting to dynamic production needs.

REFERENCES

[1] C. Finnsgård and C. Wänström, "Factors impacting manual picking on assembly lines: an experiment in the automotive industry," ***International Journal of Production Research*****, vol. 51, no. 6, pp. 1789–1798, Mar. 2013, doi: https://doi.org/10.1080/00207543.2012.712729.**

[2] S. Suri, A. Jain, N. Verma, and N. Prasertpoj, "SCARA Industrial Automation Robot," ***2018 International Conference on Power Energy, Environment and Intelligent Control (PEEIC)*****, Apr. 2018, doi: https://doi.org/10.1109/peeic.2018.8665440.**