TwinTorque

The Humanoid Project

Details Team Members

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Problem Statement and Scope

Addressing the problem of efficient manufacturing with Autonomous Systems:

- Increased **efficiency** and **flexibility** of manufacturing processes
- **Autonomous** navigation and **safe** operation
- Environment **perception** and **collaboration** with human workers

Market Size Estimations & Indicators

- **Target Market:**
  - **Manufacturing**: useful in industries like automotive, electronics, etc. for repetitive tasks
  - **Logistics**: useful in **warehouse** for increased efficiency and reduced labor costs.
- **Market Size Indicators:**
  - **Global Industrial Robot Market:** The International Federation of Robotics (IFR) forecasts the global industrial robot market to reach **$110.3 billion by 2025**
  - **Collaborative Robots (Cobots):** Cobots are designed to work safely alongside humans. This market is expected to reach **$16.6 billion by 2025**
  - **Mobile Robotics Market:** Expanding rapidly due to the growing automation. This market is projected to reach **$114.4 billion by 2025**

Target Market & Opportunity

User Segment:

- **Manufacturing and Production:**
  - Automotive: Assembly lines, parts handling, quality inspection
  - Electronics: Circuit board assembly, component placement
- **Warehousing and Logistics:**
  - E-commerce: Order picking, packing, palletizing
  - Distribution Centers: Material handling, inventory management, sorting

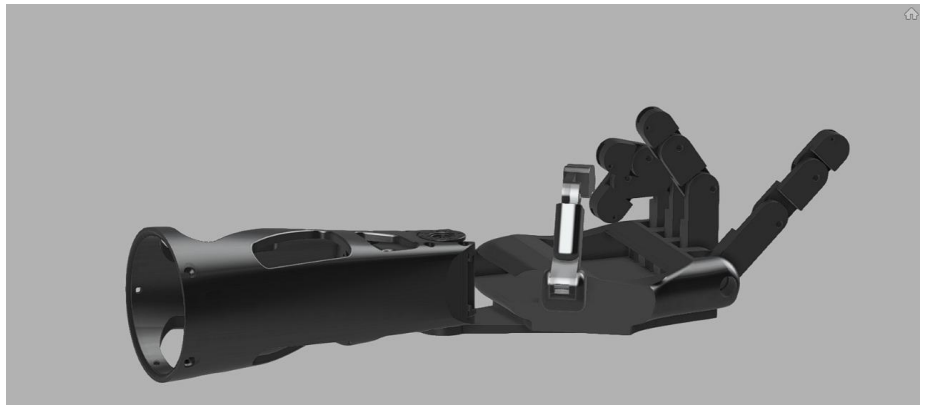
Value Addition:

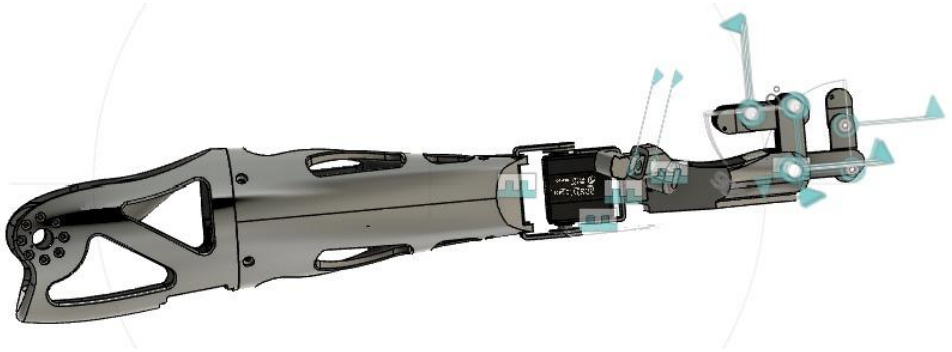
- Increased Productivity
- Improved Efficiency
- Enhanced Safety

Work Progress

- Literature reviews on Dual arm robotics
  - Links to Papers in References slide
- Designed CAD models for robotic arms.
  - Researched about problem specifications and finalise the dimensions for the bot
  - Done topology optimisation and stress strain analysis

PLA 3D printed prototype





Work Progress

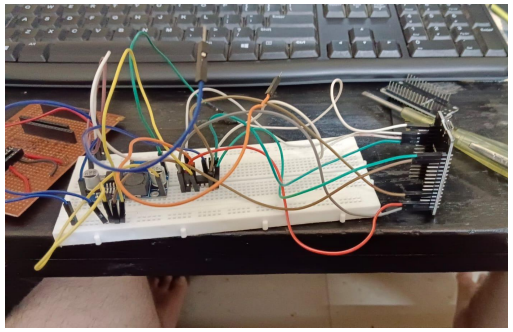
Mechanical Subdivision:

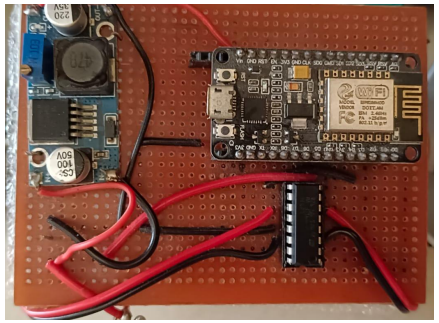
- Manufacturing robotic arm using 3D printing (in progress)

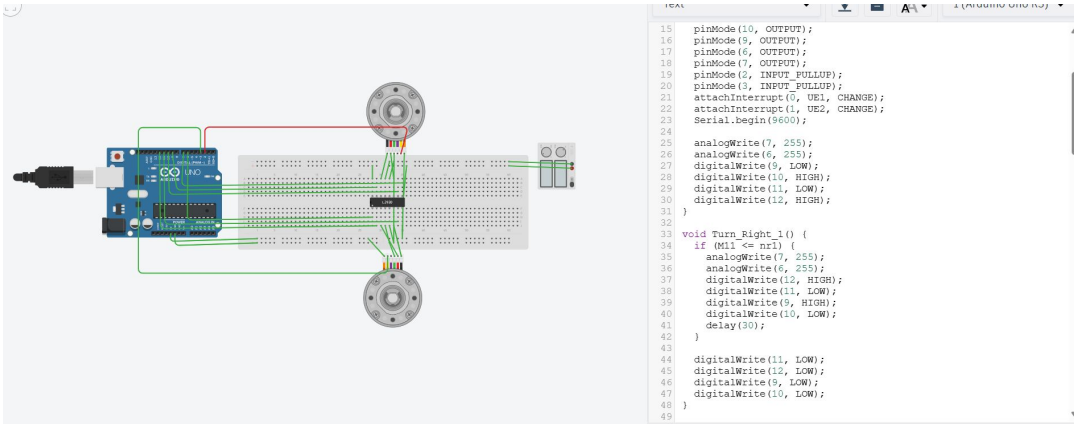
*video for 3d printing progress

Electronics Subdivision:

- Motor drivers, differential drive on ESP32



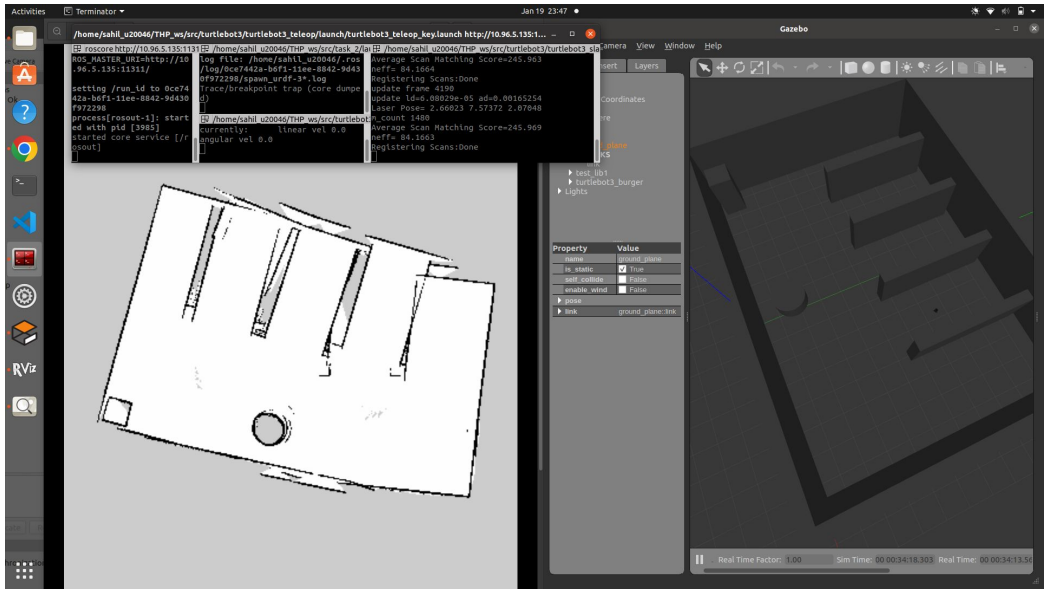




Work Progress

Controls and navigation:

- ROS 2 and gazebo simulations using turtle bot
- SLAM implementation (in progress)



AI and Perception:

- Using Stereo Camera for Perception
- Powered on Jetson Nano Developer kit for GPU acceleration for AI task load -> Object detection

Future Work

In next 2 Months:

- Completion of manufacturing robot parts
  - Wheel Base, Torso manufacturing
- Hardware Software Integration
  - ROS setup on Jetson Nano kit with Object detection model
- Electronics
  - PCB designing (in progress)
  - Servos - controls implementation
- Test trials and fine tuning

After the competition:

- Make market ready dual arm cargo bot (industry level)
  - Enhance performance using robust motors and industry grade electronics
  - perception using more sensors like Lidars
  - Using better material eg., Aluminium
- Explore Bipedal robotics for manufacturing industries

Challenges

- **Precision manufacturing:** Achieving the required precision while manufacturing the mechanical components, especially for intricate parts
- **Strength and Durability issues with materials**: PLA 3D printing is chosen due to its low costs but compromising on strength in turn compromising on the bot's structural integrity to handle the intended loads
- **Electrical system integrations:** PCB designing, wiring & connections, power management
- **Software development:** integration with hardware (jetson, arduinos) with software base (ROS2, python scripting)

References

- ROS Robots
  - JetAuto ROS Robot - NVIDIA Developer
  - JetAuto Pro ROS Robot Car
- Papers on dual arm robots
  - Dual-Arm Collaborative Robot for Future Smart Factories
  - Robotized Assembly Using Dual Arm Robots
  - A Collaborative Control of Dual-Arm Robots via Deep Reinforcement Learning
- SLAM implementation
  - Implement SLAM with Lidar Scans - MATLAB
  - Path Planning Using Potential Field Algorithm
  - SLAMbook-goaxiang
- 3D depth analysis
  - OpenCV- Stereo-camera construction and testing