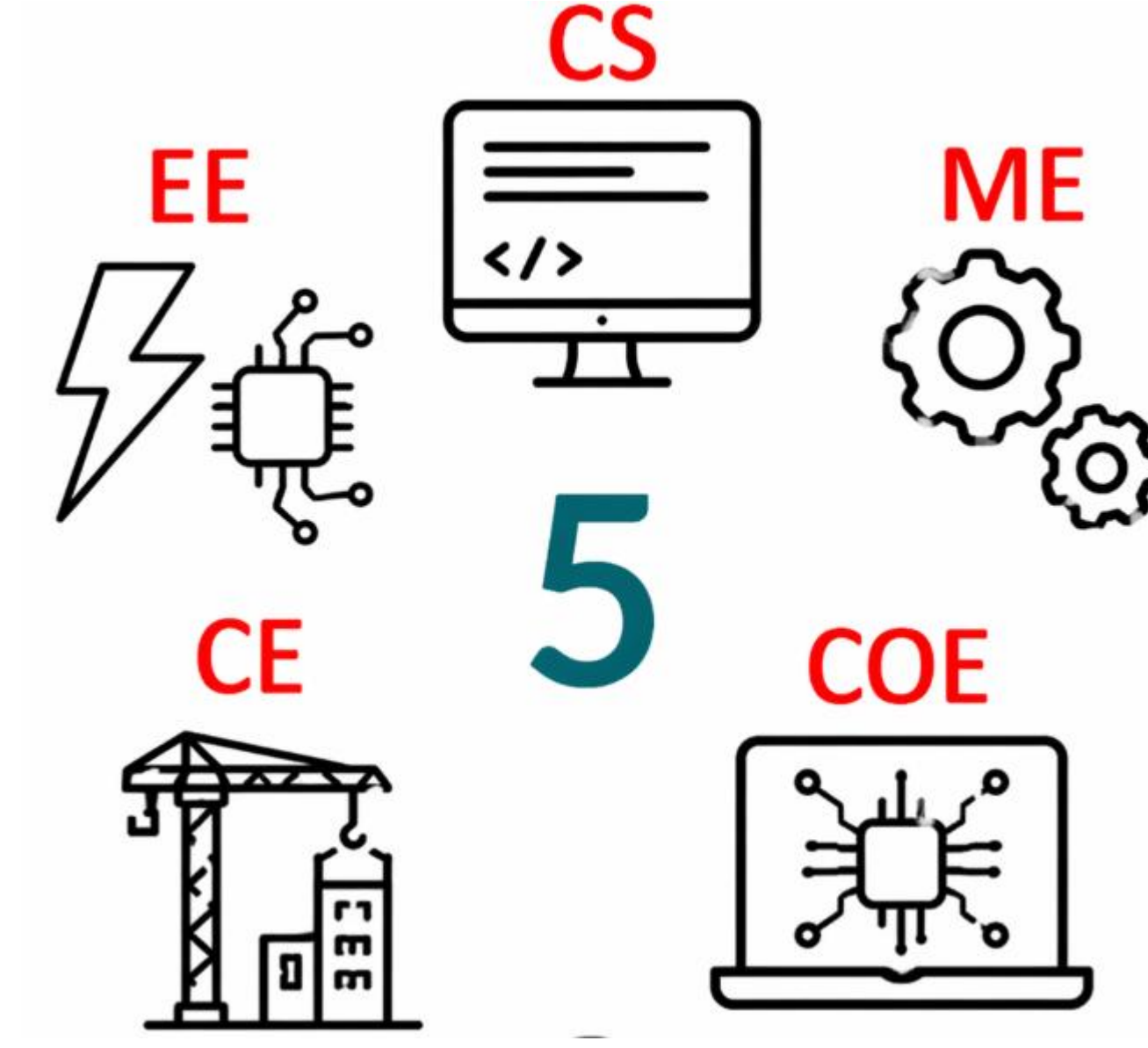


Smart Street Condition Inspection System (SSCIS)

TEAM
M087

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Background

Problem Statement:

Saudi Arabia's road network spans about **268,000 km** creating a major challenge for frequent manual inspection. In **2024**, the Kingdom recorded over **17,200 serious traffic accidents**, with **60.3% occurring inside cities**, where pavement defects and localized road deterioration can affect safety and maintenance quality. The Ministry of Municipalities and Housing has also introduced a **unified digital road management and maintenance system**, reflecting the national need for smarter inspection tools. SSCIS addresses this gap through a mobile robotic platform that detects and records street defects using structured, location-based data.

Constraints | Specifications

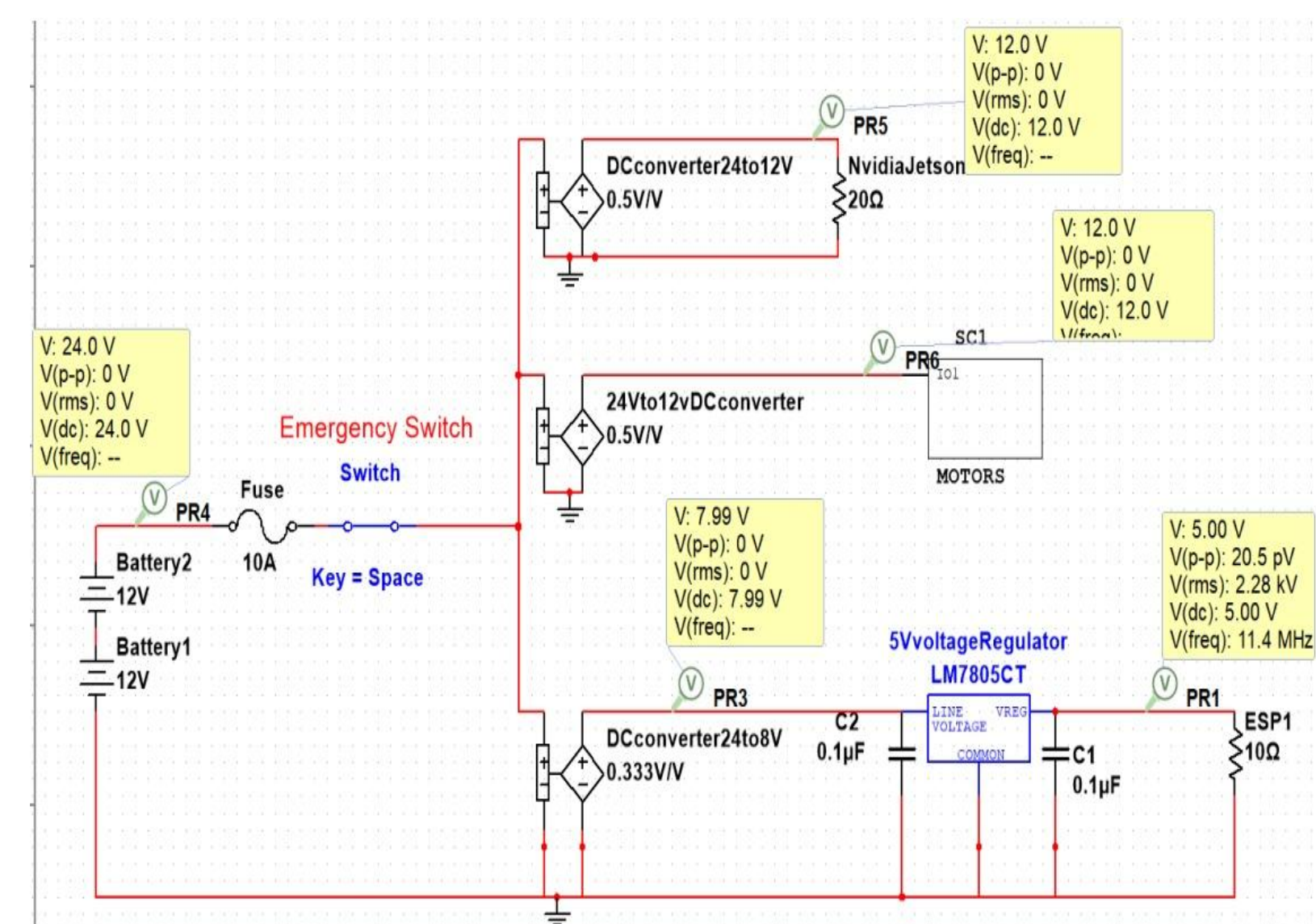
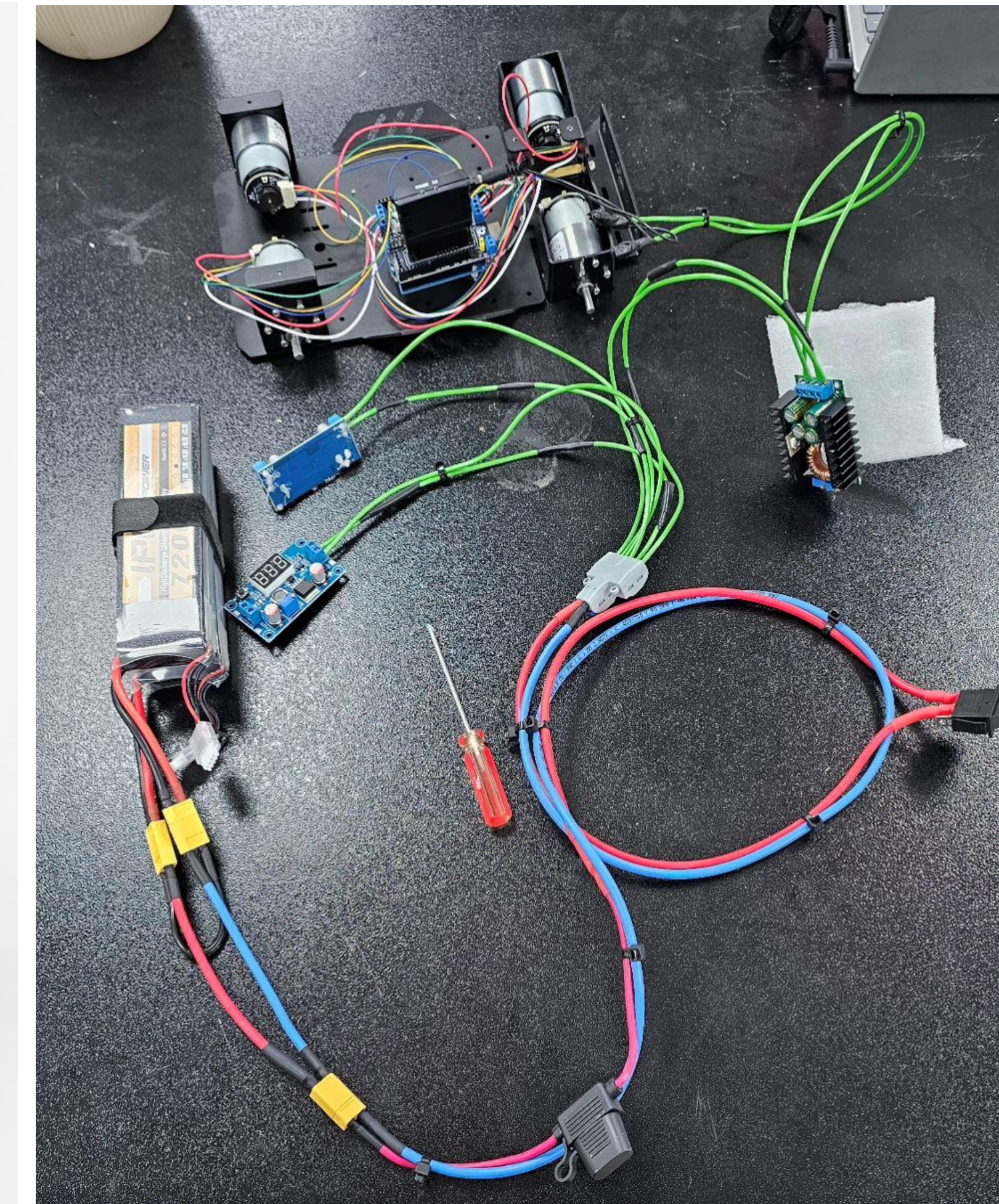
| | |
|---|---|
| Electrical Power Budget: Electrical power consumption during nominal operation shall not exceed 300 W, measured at battery output under nominal conditions. | DC Rail Regulation: Provide regulated DC rails 19V - 5V with regulation $\pm 5\%$ under expected load variation. |
| Offline-capable operation (no continuous internet, local storage of reports) | Sensor Power Quality: Voltage ripple on sensor power rails supplying LiDAR + RGB camera shall be $< 5\%$ under nominal operation. |
| Total robot mass (including battery + sensors + enclosure) shall be $\leq 35\text{kg}$ | Electrical Safety Implementation: Electrical design shall prevent exposed energized conductors and include overcurrent protection (fuses 10A(main)/BMS 10Ah) supporting safe public operation using IEEE standards. |
| deployable on residential asphalt and concrete streets, detecting cracking (both pavement types) for network-level maintenance planning. | shall correctly identify the presence of predefined distress types (cracking and rutting) within 6-meter pavement segments with $\geq 90\%$ accuracy |

Prototype Design

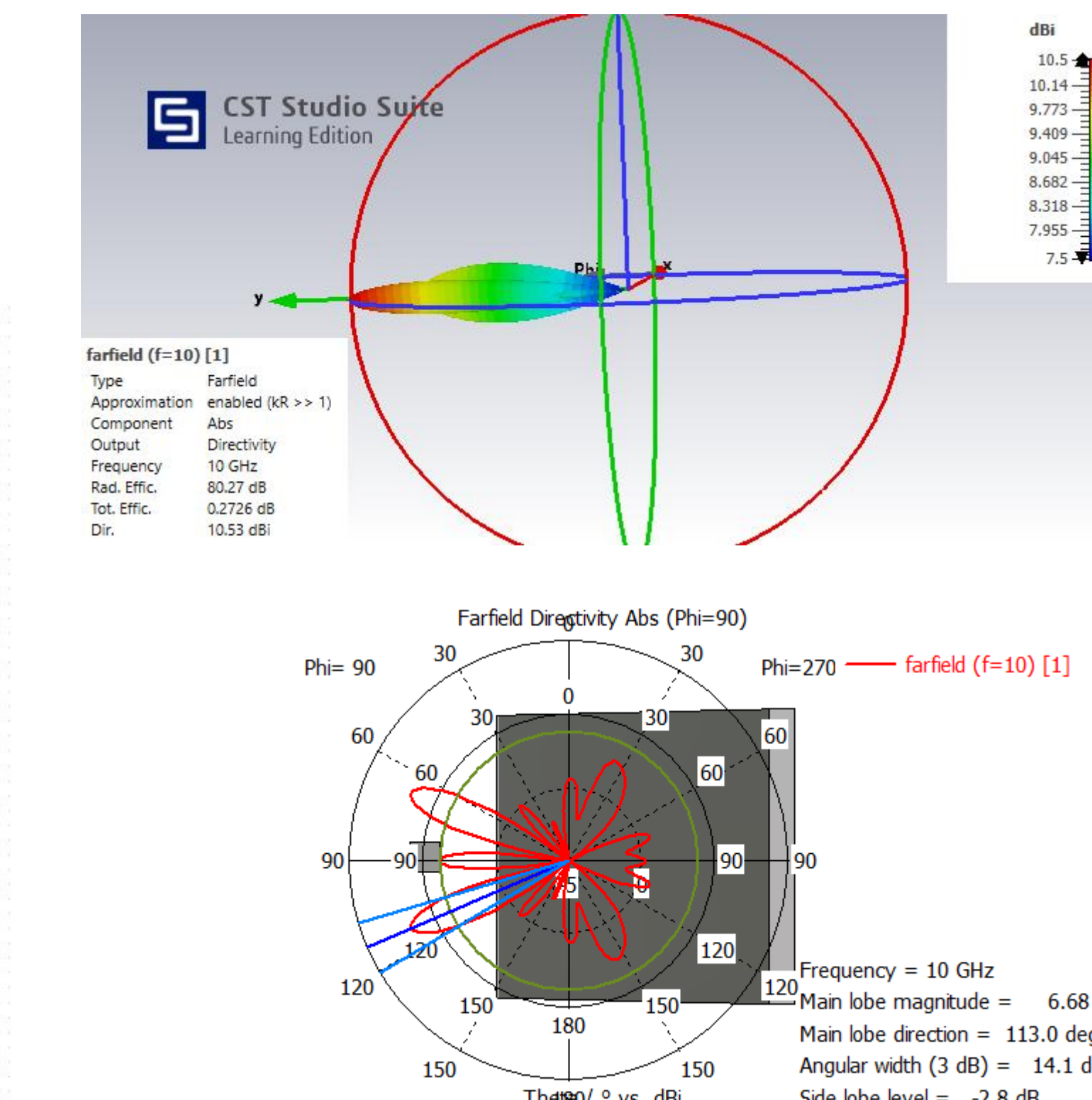
CAD Design



Internal Components



Power Circuit
Multisim Simulation



LiDAR EM wave
CST Simulation

Testing Dashboard

| Test Item | Validation Method | Result | Status |
|-------------------------------|---|--|--------|
| DC rail regulation | Simulation + multimeter check | 5 V within $\pm 5\%$ under load | Pass |
| Power budget | System-level power calculation | Did not exceed 300 W maximum allowed | Pass |
| Sensor power supply | Output verification to LiDAR and RGB camera | Stable regulated supply delivered | Pass |
| Offline operation | Functional check without internet | Local logging and processing achieved | Pass |
| Structural mass limit | Prototype weight check | $\leq 35\text{ kg}$ including battery, sensors, and enclosure | Pass |
| Defect detection performance | Prototype testing on sample pavement segments | $\geq 90\%$ accuracy for crack/rutting detection within 6 m segments | Pass |
| LiDAR coverage representation | CST Studio far-field / polar plot | 1° elevation, 62° azimuth lobe visualized | Pass |
| Power-system behavior | Multisim simulation vs hardware reading | Simulation matched measured values | Pass |

Conclusion

The SSCIS prototype met its main targets with regulated **12V $\pm 5\%$** supply, stable power consumption within the **300 W** limit, total cost of **SAR 4,529**, and **$\geq 90\%$** defect-detection accuracy over **0.6 m** pavement segments. These results confirm SSCIS as a feasible, low-cost proof of concept for smart street-condition inspection.