DEVELOPMENT OF ROAD SURFACE MARKING ROBOT

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Introduction:

- Road surface markings are essential for guiding drivers, maintaining traffic discipline, and ensuring road safety.
- There are still many road markings that use manual painting systems that require operator guidance on the road that will be marked as road markings.
- The work of painting road markings that still require a long period of preparation cannot directly update the road markings that have worn out as well as being an influence, which cannot be done suddenly.
- The integration of robotics and automation offers an effective solution to improve efficiency, accuracy, and safety in road marking operations.
- A road surface marking robot is designed to autonomously apply paint or thermoplastic materials on road surfaces following predefined paths and geometrical.

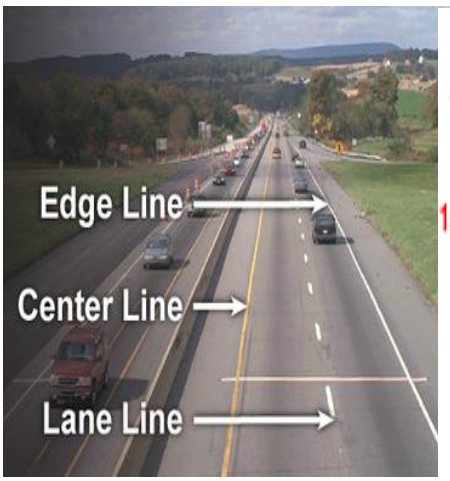

Figure 1: Road line markings

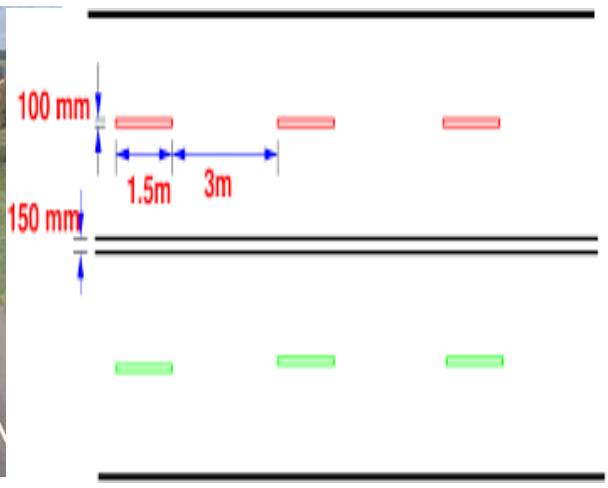

Fig 2: Road marking dimensions

Objectives:

1. To carry out a literature review on road surface marking robot and mechanism involved in road marking.
2. To arrive at design specification of road Surface Marking robot.
3. To develop different design Concepts of the road Surface marking robot and selection of best concepts.
4. To carry out the detail design of the selected Concept & to integrate the Control System.
5. To fabricate the Prototype & carry out the field test.

Methodology:

Objective No.	Statement of the Objective	Methodology	Resources Utilised
1	To carry out a literature review related to development of road surface marking robot of Mechanism involved in road marking.	• To carry out literature review of journal papers, books to study various spraying mechanisms. • Analyze existing Road marking robots.	• Internet • Journal • Books
2	To arrive at design specification of road Surface Marking robot.	• Record design parameters such as tank capacity, nozzle type, paint flow rate, and marking precision. • Identify problems in current manual and semi-automatic models (e.g., irregular marking, paint wastage).	• Camera • Road inspecti on tools
3	To develop different design Concepts of the road Surface marking robot and selection of best concepts.	• Develop multiple conceptual designs for the paint feeding and marking systems of the road surface marking robot, focusing on automation, precision, and material efficiency. • Select the optimal design concept based on defined specifications such as marking accuracy, ease of operation and cost.	• Software Tools • Field Data
4	To Carry out the detail design of the selected Concept & to integrate the Control System.	• Concept Refinement and Requirements Definition. • Control System Design and Integration.	• Software
5	To fabricate the Prototype & carry out the field test.	• Testing and calibration of the prototype. • Live demonstration of the prototype.	• Workshop • Field test

Result and Conclusion:

Figure 2: Prototype on field test

Figure 3: Painting Result (150 mm width)

Conclusion:

The project successfully demonstrated the design and development of a semi-automated road surface marking robot capable of performing basic road line painting operations with improved consistency compared to manual methods. The system integrates a mechanical chassis, hub-motor drive system, electronic control unit, and a spray-based paint deposition mechanism into a single functional platform.

- Study showed that spray-based robotic marking is more accurate, safer, and more consistent than manual road marking methods.
- Proper design calculations ensured the robot can produce a 150 mm wide line with correct speed, paint flow, and power capacity.
- Among all concepts, the spray nozzle system was the best for uniform paint application and reduced wastage.
- Mechanical parts, motors, pump, and Arduino control were successfully integrated to synchronize robot movement and paint spraying.
- The fabricated prototype was able to mark straight, continuous lines in testing, proving the system works effectively.

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Future Scope:

The developed prototype provides a strong foundation for further advancement toward a fully autonomous and industrial-grade road marking system. Future work can focus on integrating machine vision and image-processing systems for automatic lane detection and curved path marking, enabling the robot to operate without continuous human guidance. The addition of closed-loop control using sensors such as encoders and pressure sensors would improve precision in speed regulation and paint flow, ensuring consistent marking quality under varying surface conditions. Expanding the marking mechanism to support dashed lines, symbols, and complex road patterns would broaden its real-world applicability. Mechanical improvements such as suspension or terrain-following mechanisms could help maintain constant nozzle height on uneven surfaces, while upgrades to industrial paint systems, including thermoplastic application and reflective bead integration, would enhance durability and compliance with highway standards. Energy management, safety features like obstacle detection and emergency stop systems, and the possibility of coordinated multi-robot deployment for large-scale projects represent further directions for development, ultimately transforming the prototype into a robust, intelligent, and scalable road infrastructure automation solution.