



Solutions to Prevent Heat Stroke Deaths in Vehicles: Ensuring Safety for Infants and Pets

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ABSTRACT

The increasing incidence of heatstroke deaths among children and pets left in vehicles highlights the critical need for effective preventive solutions. This research aims to analyze existing technologies, identify their limitations, and develop a more efficient, universally compatible system. Our analysis revealed significant shortcomings in existing products, such as dependency on internet connectivity and incompatibility with various vehicle models. Our prototypes addressed these issues with a standalone system that enhances safety without mobile devices. The final solution demonstrated substantial improvements in reliability and ease of installation, incorporating multiple components such as pressure sensors, Hall effect sensors, and infrared sensors, ensuring continued operation even if one sensor fails. The alert mechanisms, including a beeper and the car's internal horn, are designed to function independently from other components. The system uses a solar panel charger for the control unit and rechargeable batteries for the sensors, all connected via Bluetooth. This design creates a functional design with backup features using different sensors and alerting devices, preventing accidents and deaths caused by heat strokes on infants and pets, and improving vehicular safety for all families.

INTRODUCTION

The increasing number of child and pet heatstroke deaths in vehicles, often due to the "Forgotten Baby Syndrome," underscores a critical safety issue that demands innovative solutions. This project investigates various technological interventions to prevent these incidents, aiming to develop a more efficient, affordable, and universally compatible system. To enhance the system's effectiveness, we implement multiple sensors that serve as backups, ensuring increased reliability and safety.

Pediatric Vehicular Heatstroke Deaths (1998-2024)

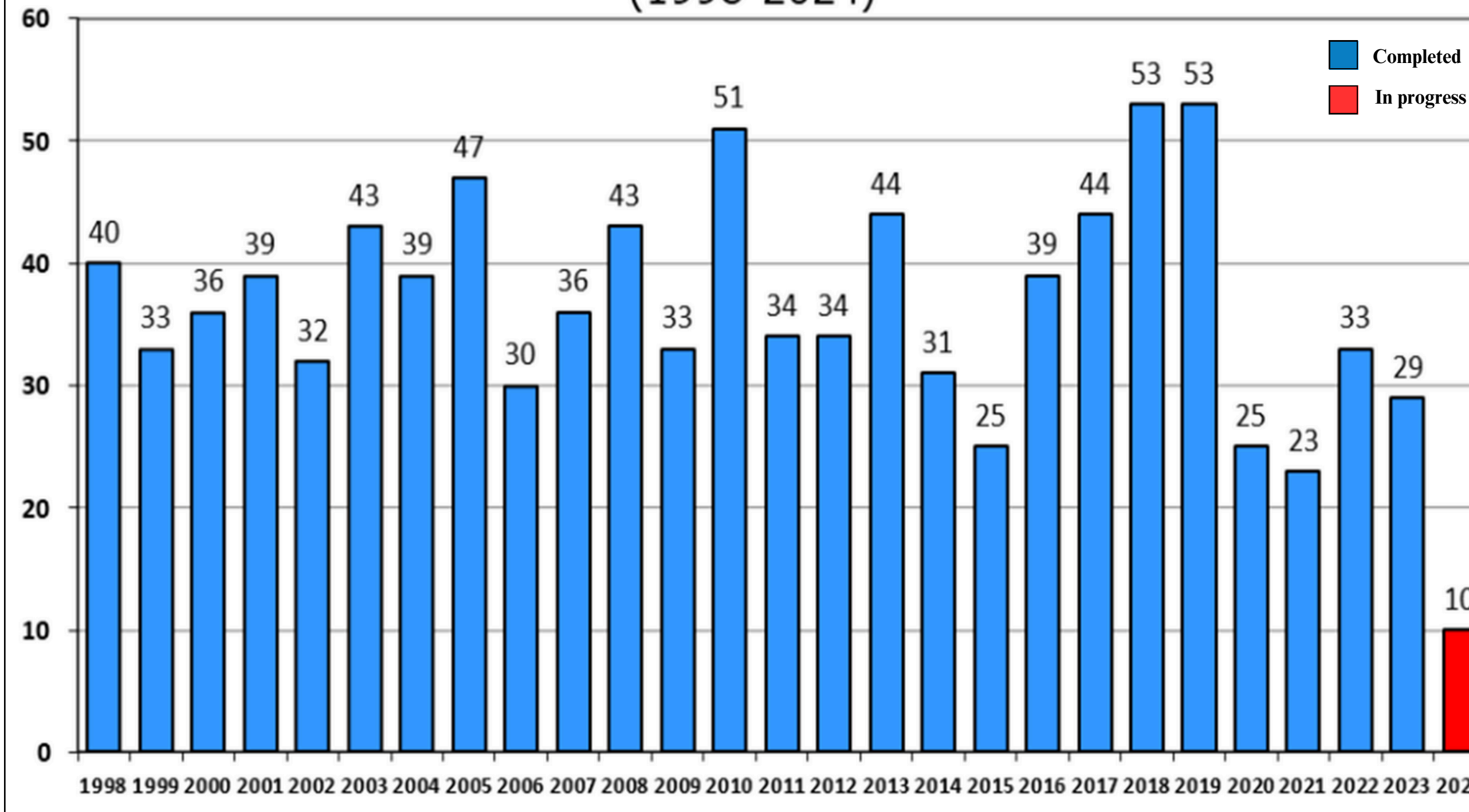


Figure 1. Pediatric Vehicle Heat Stroke Deaths in the United States from 1998-2024 (San Jose State University, 2024)

OBJECTIVES

The objective of this research is to analyze current solutions for preventing child heat stroke deaths in vehicles, identifying their strengths and weaknesses, to design and prototype an affordable, user-friendly alternative that doesn't rely on mobile devices and is compatible with all vehicle models. Additionally, the system will incorporate multiple backup sensors to ensure continued functionality and effectiveness, even if one component fails.

METHODOLOGY

The methodology of this research consist of 3 phases:

I. Data Collection on Car's Internal vs External Temperatures

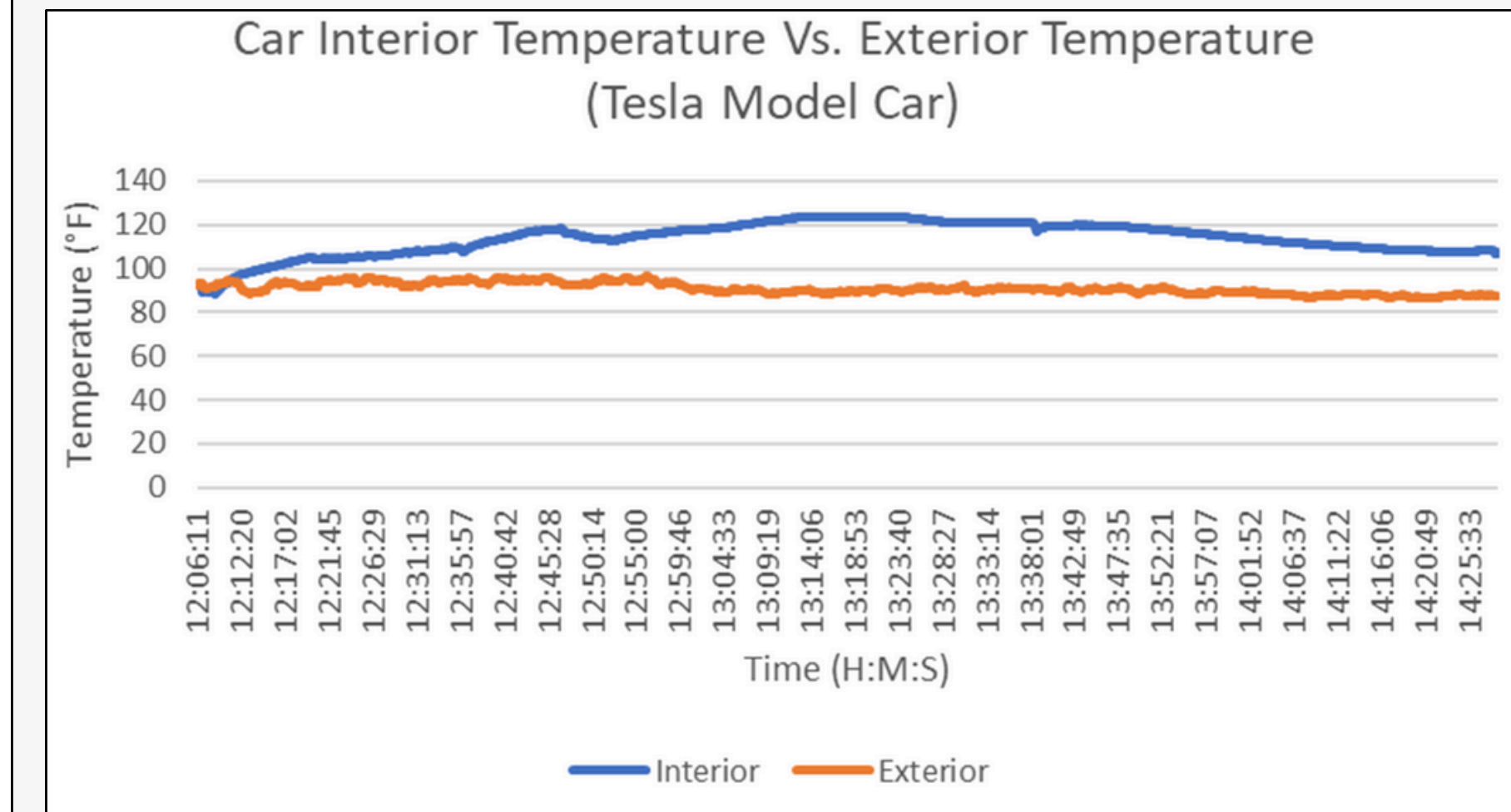


Figure 2. Car Interior Temperature vs Exterior Temperature

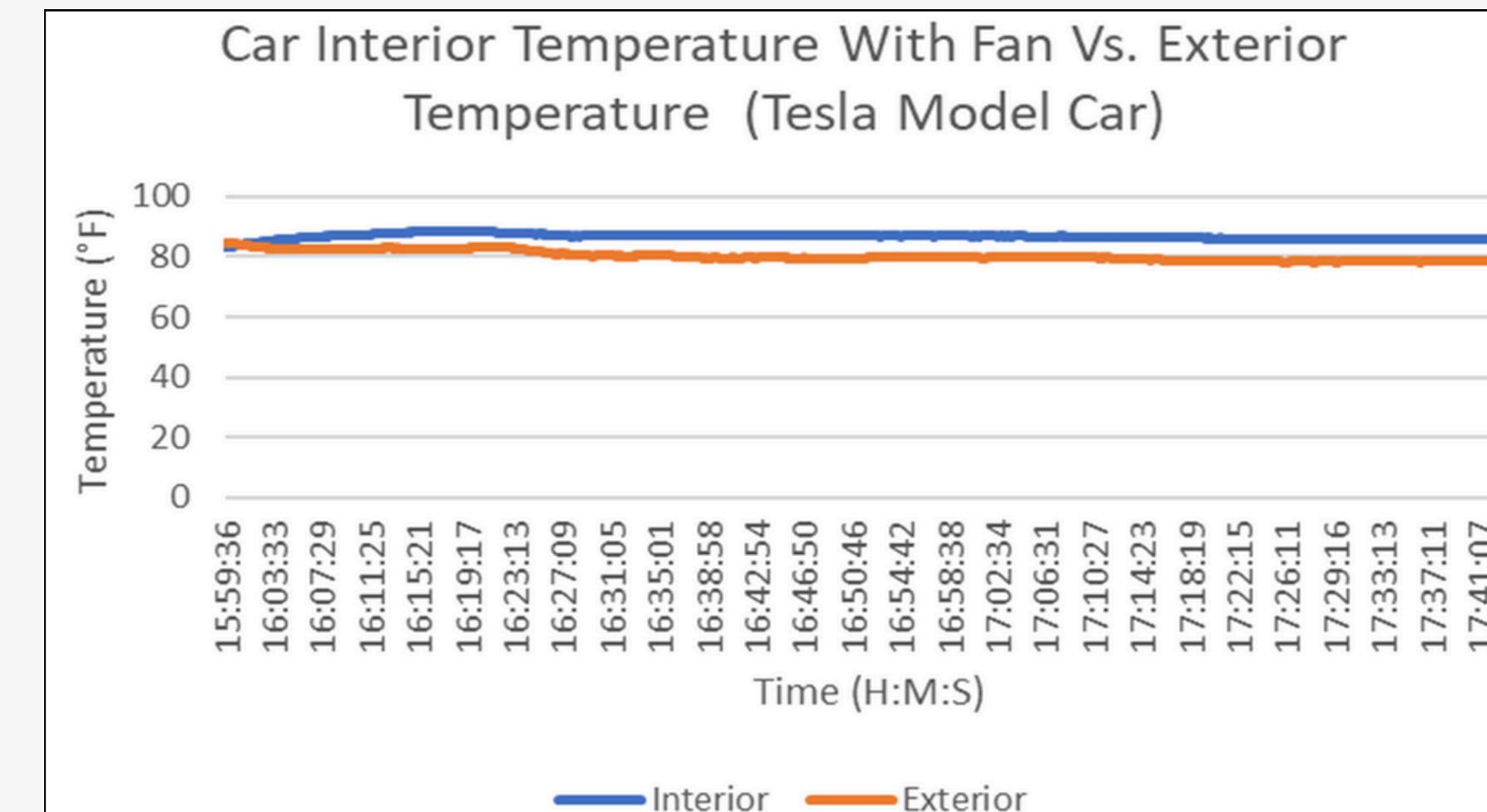
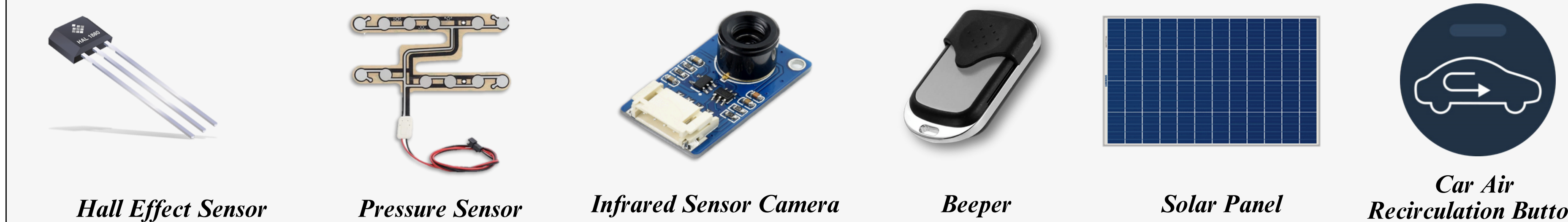


Figure 3. Car Interior Temperature with Fan vs Exterior Temperature

II. Solution Parameters



III. Prototypes and Preliminary Designs

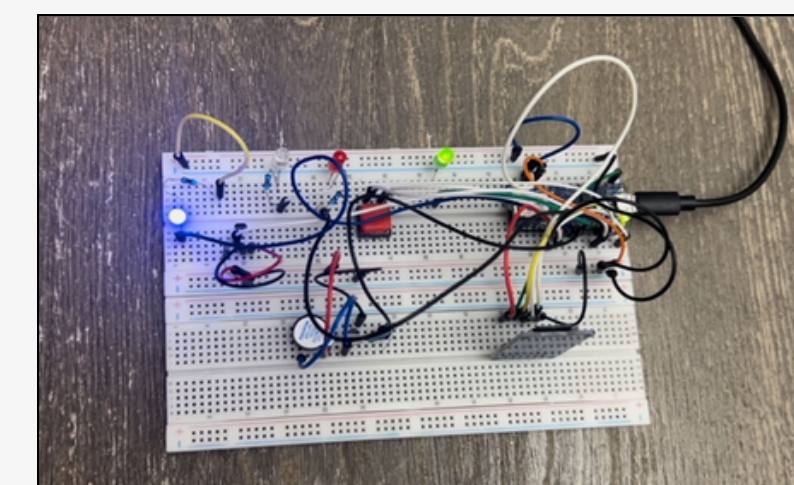


Figure 3. First Circuit Prototype Version

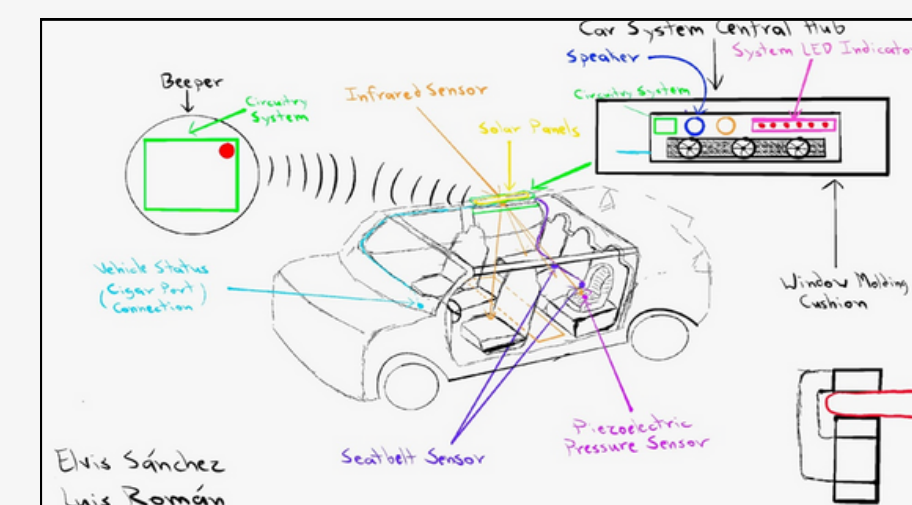


Figure 4. Preliminary System Installation (Román & Sánchez, 2024)

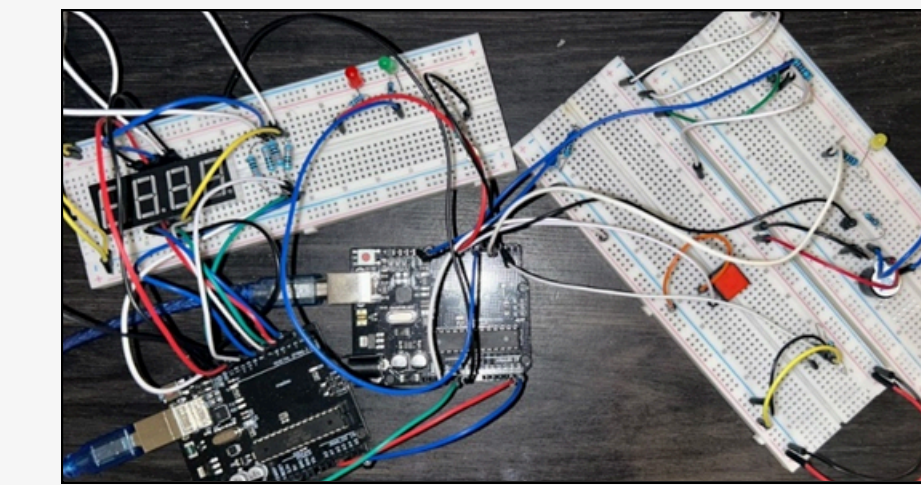


Figure 5. Second Circuit Prototype Version

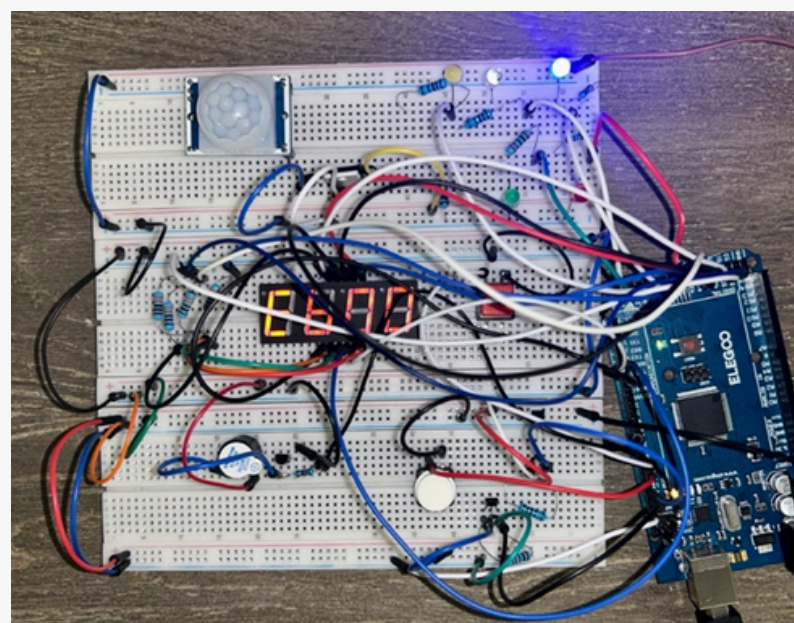


Figure 6. Third Circuit Prototype Version

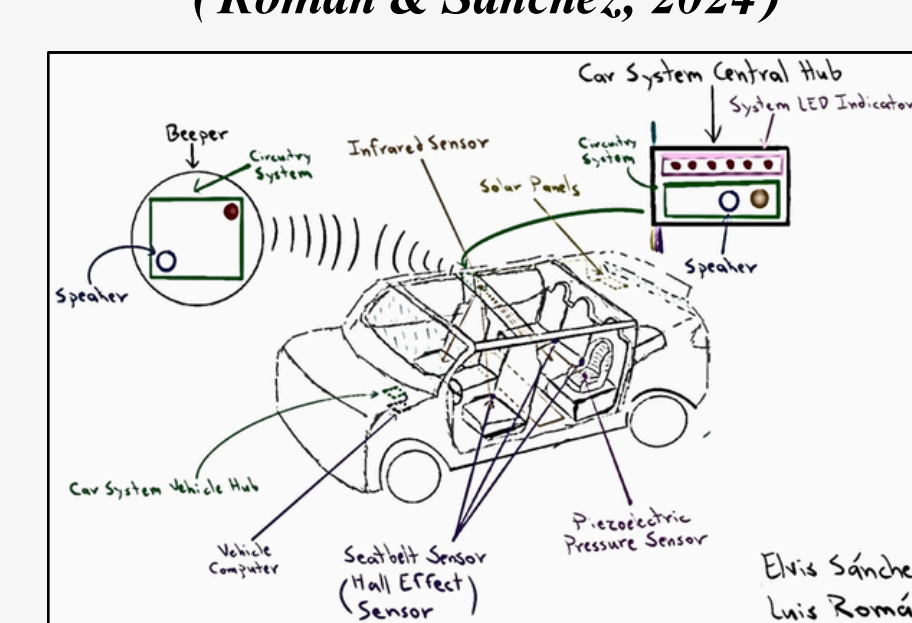


Figure 7. Second Version of System Installation (Román & Sánchez, 2024)

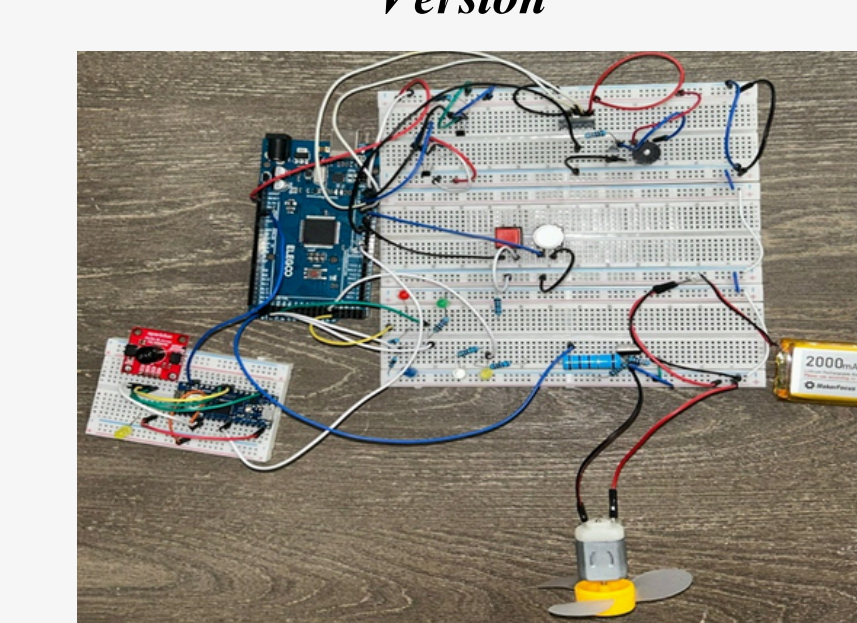


Figure 8. Fourth Circuit Prototype Version

FINAL SOLUTION AND RESULTS

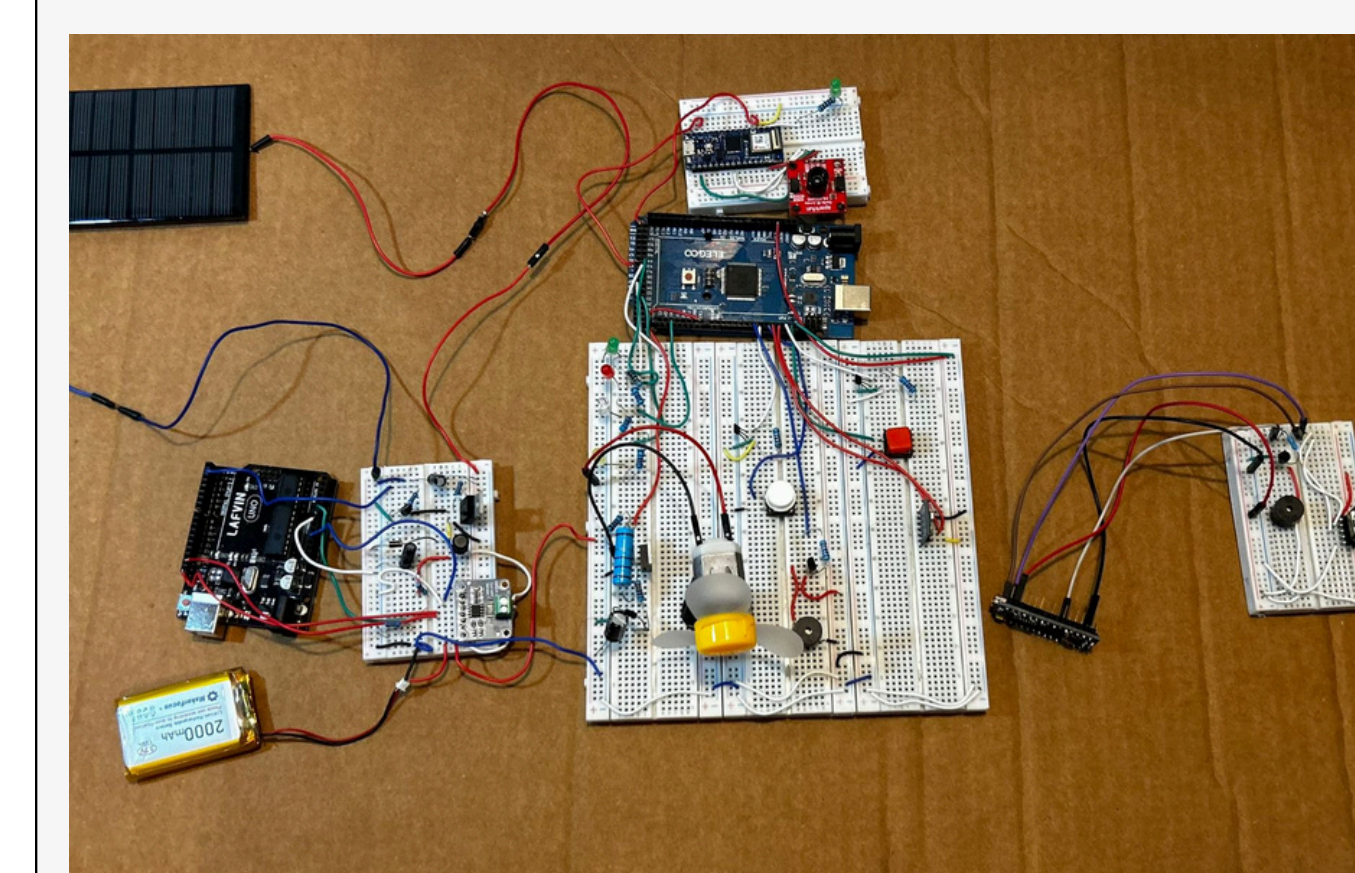


Figure 9. Final Circuit Prototype

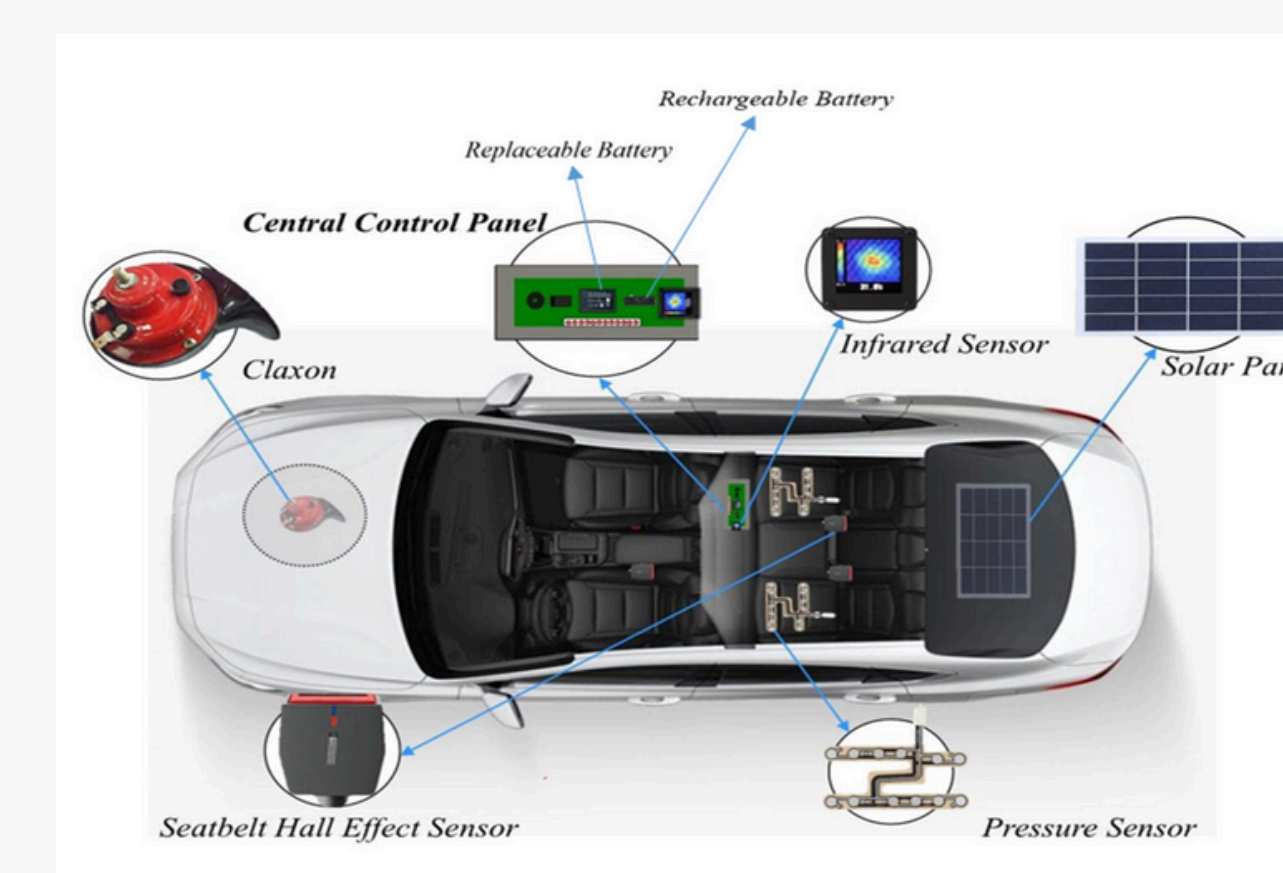


Figure 10. Final System Design and Installation (Román, Sánchez & Sánchez, 2024)



Figure 11. Beeper Design

CONCLUSION

The developed system, with a final prototype cost of \$71.24, effectively prevents infant and pet heatstroke incidents, addressing limitations and weaknesses of existing technologies. It is affordable, compatible with all car models, and independent of mobile devices. The system's reliability is enhanced by multiple sensors and alert mechanisms that ensure the detection of individuals left in the car and alert caregivers of the incident. As an optional enhancement, a proposed feature utilizes the car's recirculation button to expel hot air, requiring mechanical intervention.

FUTURE WORK

As the results showed that this system would be a more effective solution than current existing technologies, future research recommendations include:

- Fabricate PCBs for advanced prototyping.
- Utilize 3D printing for precise prototype development.
- Expand scale model demonstrations for increased complexity.
- Seek feedback from car manufacturers for system integration.
- Identify and incorporate additional features for future integration.

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360° VIDEO SYSTEM DEMONSTRATION

