A Project Report

on

Smart HMI's for Automobiles

Submitted in partial fulfillment of the
requirement for the award of the degree of

Bachelors of Technology

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Under The Supervision of
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CANDIDATE'S DECLARATION

We hereby certify that the work which is being presented in the project, entitled **"Smart HMI's for automobiles"** in partial fulfillment of the requirements for the award of the Bachelors of technology submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of march, 2023 to June and 2023, under the Dr. Nitesh Bhati Assistant Professor , Department of Computer Science and Engineering, Galgotias University, Greater Noida

The matter presented in the project has not been submitted by us for the award of any other degree of this or any other places.

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Dr. Nitesh Bhati

Assistant Professor

CERTIFICATE

The Final Project Viva-Voce examination of Anuj Srivastava (20scse1180035), Shaleen Kaushik (20scse1180028), Rishabh Jain (20scse1010642) has been held on _____ and his/her work is recommended for the award of Bachelor of technology.

Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Project Coordinator **Signature of Dean**

Date: November, 2013

Place: Greater Noida

Abstract

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Paragraph-2 Proposed Solution- 6-8 Lines
Paragraph-3 Tools and Technology Used- 3-5 lines
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Acronyms

B.Tech.	Bachelor of Technology
M.Tech.	Master of Technology
BCA	Bachelor of Computer Applications
MCA	Master of Computer Applications
B.Sc. (CS)	Bachelor of Science in Computer Science
M.Sc. (CS)	Master of Science in Computer Science
SCSE	School of Computing Science and Engineering

CHAPTER-1

Introduction

1.1 Introduction

Smart Human-Machine Interface (HMI) is a technology that allows for seamless and intuitive interaction between the driver and the automobile dashboard. The HMI system combines various technologies, such as voice recognition, gesture control, and touch screen displays, to provide a user-friendly interface that can be easily accessed and controlled by the driver.

The smart HMI technology enables the driver to interact with the dashboard and vehicle systems in a more personalized way, making driving a more enjoyable and safer experience. With the use of smart HMI, drivers can access various vehicle systems, including entertainment, navigation, climate control, and safety features, without taking their hands off the wheel or their eyes off the road.

Smart HMI technology also provides real-time information to the driver, such as fuel efficiency, engine performance, and battery life. This information can be displayed on a dashboard or on a head-up display (HUD) that projects information onto the windshield, allowing the driver to view important information without taking their eyes off the road.

1.2 Formulation of the problem

Analog or semi-digital dashboards have been a popular feature in cars for many years, but they do have some limitations and problems compared to the modern smart HMI technology.

One of the main problems with analog or semi-digital dashboards is their limited functionality. They typically have a fixed set of gauges and dials that display basic information, such as speed, fuel level, and engine temperature. This means that they cannot display more detailed or personalized information, such as traffic updates or navigation instructions.

Another problem is that analog or semi-digital dashboards can be difficult to read and interpret, especially for inexperienced drivers or those with visual impairments. The gauges and dials are often small, and the information they display can be hard to see in certain lighting conditions, such as bright sunlight or low light.

Analog or semi-digital dashboards also require the driver to take their eyes off the road to interpret the information being displayed. This can be dangerous, especially in situations where split-second decisions need to be made.

Finally, analog or semi-digital dashboards can be less reliable and prone to mechanical failure. The gauges and dials can become stuck, or the backlighting can fail, making it difficult or impossible to read the information being displayed.

Overall, while analog or semi-digital dashboards have served their purpose well, they are becoming increasingly outdated as more advanced smart HMI technology becomes available.

Smart HMI technology offers greater functionality, flexibility, and safety features, making it the preferred option for many modern car manufacturers.

1.2.1 Tools and Technology Used

The development of a smart Human-Machine Interface (HMI) using Qt and QML involves several steps:

1.) **Designing the User Interface:** The first step is to design the HMI, which includes the layout of the interface, the selection of colors and fonts, and the placement of controls. QML is used for designing the user interface, which allows for the creation of a highly customizable interface.

2.) **Implementing the Interface:** After designing the user interface, the next step is to implement it using Qt. Qt provides a set of libraries for creating desktop and mobile applications, which includes a wide range of UI components such as buttons, text fields, and sliders.

3.) **Adding Smart Features:** To make the HMI smart, it is necessary to add features such as data visualization, real-time data updates, and intelligent data analysis. Qt provides several libraries for data visualization and analysis, such as Qt Charts and Qt Data Visualization.

4.) **Integration with the Back-end:** The HMI needs to be integrated with the back-end system that provides data to the application. This can be done using protocols such as MQTT or OPC UA, which allow for real-time data exchange between the HMI and the back-end system.

5.) **Testing and Deployment:** Finally, the HMI needs to be tested to ensure that it meets the requirements and works as expected. Once it passes testing, it can be deployed to the target platform, which may include desktops, mobile devices, or embedded systems.

Overall, the development of a smart HMI using Qt and QML involves a combination of design, programming, and testing, with a focus on creating a user-friendly and intelligent interface that meets the needs of the end-users.

CHAPTER-2

1.) Literature Survey

HMI for Automobiles:

1.) "A Review of Automotive Human-Machine Interface Design Research" by Han Bai and Jia Xu. This paper presents a systematic review of research on automotive HMI design, including studies on the use of touchscreen displays, voice-based interfaces, and augmented reality technologies.

2.) "User Interface Design of Automotive Dashboards: A Review of Relevant Research" by Peter Robinson and Nadine Boland. This paper provides an overview of research on dashboard design, focusing on the importance of user-centered design and the need for interfaces that are both usable and engaging.

3.) "Usability of In-Car Interactions: A Literature Review" by Kaisa Väänänen-Vainio-Mattila and Anu Kujala. This paper provides a comprehensive review of research on the usability of in-car interactions, including dashboard design, voice-based interfaces, and other forms of HMI.

4.) "Human Factors in Automotive Design: A Review of Relevant Research" by Sebastian Lo and John Lee. This paper provides a comprehensive review of research on human factors in automotive design, including dashboard design, driver distraction, and the effects of automation on driver behavior.

5.) "A Survey of Automotive Human Machine Interface Technologies" by Xiaolan Wu, Wei Liu, and Xiaowei Wang. This paper provides an overview of HMI technologies used in automotive design, including display technologies, voice recognition systems, and gesture recognition systems.

Normal HMI Use Cases for IoT:

1.) "A Survey of Human-Computer Interaction for the Internet of Things" by Hyo-Jeong So and Kyung-Sun Kim. This paper provides an overview of HCI research in the context of IoT, including studies on interaction modalities, user interfaces, and usability.
2.) "Human-Computer Interaction in the Internet of Things: A Survey" by Rami Alzoubi, Omar Alshathry, and Hussein Al-Bahadili. This paper provides a review of research on HCI for IoT, including studies on context-awareness, natural language interfaces, and sensor-based interaction.
3.) "A Survey of Human-Machine Interaction in IoT" by Wenjie Li, Jianfeng Ma, and Jun Wang. This paper provides an overview of research on HMI for IoT, including studies on user interfaces, voice-based interfaces, and gesture recognition.
4.) "HCI and IoT: A Review of Research and Challenges" by Eiman Kanjo and Hassan Jameel. This paper provides a comprehensive review of research on HCI for IoT, including studies on user experience, multimodal interaction, and privacy.
5.) "Designing for the Internet of Things: A Review of User-Centered Design Approaches" by Hamed Alavi, Laleh Jalilian, and Kambiz Badie. This paper provides an overview of

user-centered design approaches for IoT, including studies on user requirements, prototyping, and evaluation.

These literature survey reports offer valuable insights into the design and usability of HMI for automobiles and IoT. They provide a foundation for future research in these areas and highlight the importance of user-centered design approache

Chapter - 3

3.1) Working of Project

Using C++ and QML is a great choice for designing an HMI for automobiles.

1.) **Understand the roles of C++ and QML:** C++ is used to implement the logic and functionality of the HMI, while QML is used to create the user interface. It's important to understand the roles of these technologies and how they work together to create a seamless user experience.

2.) **Design the HMI with QML:** Use QML to design the user interface for the HMI. QML provides a declarative syntax for defining the UI elements and their properties, making it easy to create a visually appealing and interactive interface.

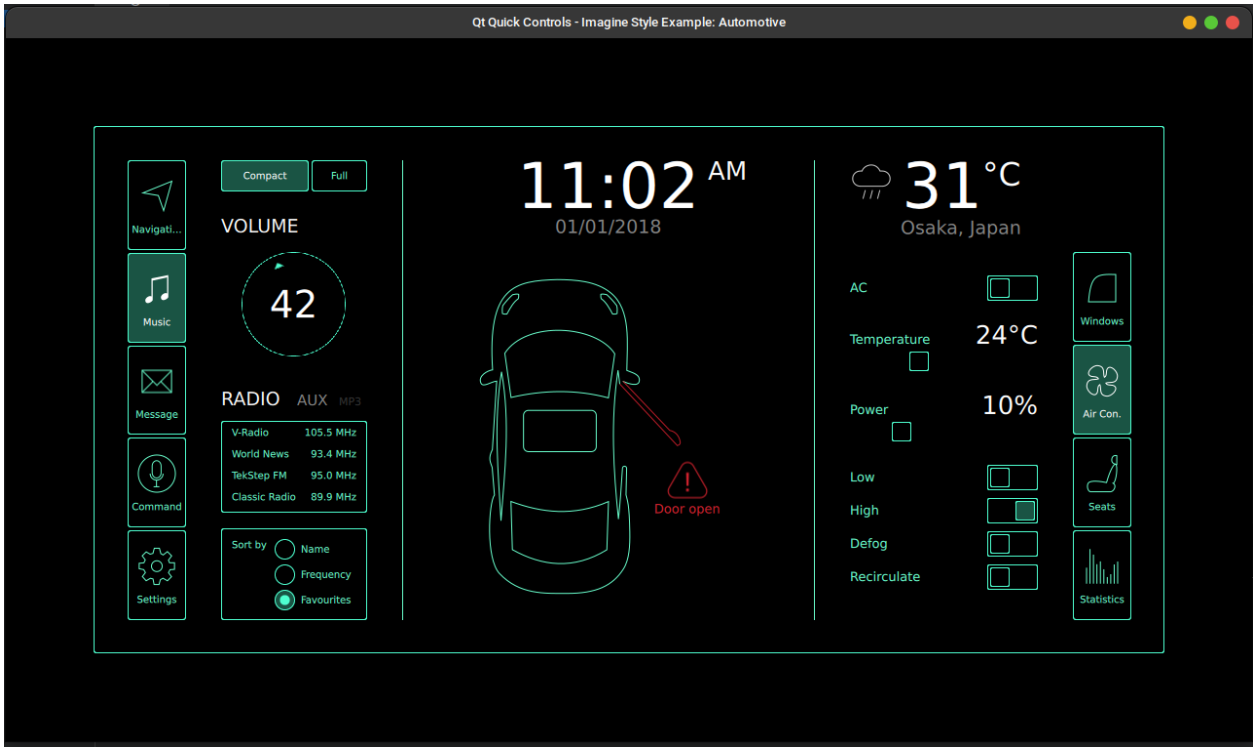
3.) **Implement the functionality with C++:** Use C++ to implement the logic and functionality of the HMI. This may involve creating classes and functions to handle user input, process data, and communicate with other systems.

4.) **Use Qt libraries:** Qt is a popular C++ framework for building graphical user interfaces, and it includes a number of libraries that can be used to simplify HMI development. For example, the Qt Quick Controls 2 library provides pre-built UI components that can be easily customized and used in your HMI.

5.) **Test and iterate:** As you build the HMI, test it frequently to identify bugs and areas for improvement. Iterate on the design and functionality until a final product that meets the needs of users.

By using C++ and QML, you can create a powerful and user-friendly HMI for automobiles. With careful planning, design, and testing, team create an HMI that enhances the driving experience and provides drivers with the information they need to stay safe and informed on the road.

A overlook of Smart HMI Module



Chapter - 4

Result

"Designing Automotive User Interfaces: A Review of Relevant Research" by Andreas Riener et al. (2018)

This paper provides an overview of the research on automotive user interfaces, highlighting the importance of user-centered design and identifying key factors that contribute to effective interfaces. The authors emphasize the need for interfaces that are easy to use, visually engaging, and provide relevant information to drivers.

"Human–Machine Interface Design for Autonomous Vehicles: A Review" by Pengbo Bo et al. (2020)

This paper explores the challenges and opportunities associated with designing human-machine interfaces for autonomous vehicles. The authors emphasize the importance of designing interfaces that are both intuitive and easy to use, while also providing drivers with the information they need to make informed decisions.

"The Effects of Vehicle Automation on Driver Workload and Situation Awareness: A Review of the Evidence" by Neville Stanton et al. (2016)

This paper examines the impact of vehicle automation on driver workload and situational awareness, highlighting the need for interfaces that minimize cognitive load and support drivers

in making effective decisions. The authors also emphasize the importance of designing interfaces that can adapt to changing driving conditions and driver preferences.

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"Touchscreen vs. Knob-Based Interfaces in Cars: Pros and Cons" by Heiko H. Horn et al. (2016)

This paper compares the pros and cons of touchscreen and knob-based interfaces in cars, highlighting the importance of considering both the user experience and the safety implications of different interface designs. The authors emphasize the need for interfaces that are easy to use and provide drivers with the information they need without distracting them from the road.

"Augmented Reality in Automotive Industry: A Comprehensive Survey" by Saeed Bakhtiari et al. (2020)

This paper explores the use of augmented reality (AR) in automotive interfaces, highlighting the potential benefits of AR for providing drivers with real-time information in a non-intrusive manner. The authors emphasize the importance of designing AR interfaces that are both visually engaging and easy to use, while also providing drivers with relevant information in a timely manner.

Chapter -5
Conculsion and Future Scope

5.1) Conclusion

The literature review suggests that there is a growing interest in user-centered design approaches for automotive dashboards, with a particular focus on the need for interfaces that are both usable and engaging. There is also a growing interest in new technologies such as voice-based and gesture-based interfaces, as well as augmented reality displays. The review highlights the need for further research in this area, particularly with respect to the design of interfaces that are tailored to the specific needs of drivers. Overall, the review provides valuable insights into the current state of research on HMI for automobile dashboards, and offers a useful foundation for future research in this area.

5.2) Future Scope

The future scope of HMI for automobiles is vast and exciting, with new advancements in technology and design promising to revolutionize the driving experience. Some potential areas for future development include:

1.) Advanced voice recognition: With the increasing popularity of voice assistants like Siri and Alexa, voice-based interfaces are becoming more common in cars. In the future, we can expect even more advanced voice recognition technology that can understand and respond to natural language commands.

2.) Augmented reality: AR technology has the potential to provide drivers with real-time information about their surroundings, including traffic patterns, road conditions, and hazards. AR interfaces could also be used to enhance navigation systems, making it easier for drivers to find their way in unfamiliar areas.

3.) Biometric sensors: Biometric sensors can measure a driver's physiological state, including heart rate, breathing patterns, and stress levels. This information can be used to adapt the HMI to the driver's needs and preferences, providing a more personalized driving experience.

4.) Advanced driver assistance systems (ADAS): ADAS technology is already being used in some cars to provide features like lane departure warning, adaptive cruise control, and automatic emergency braking. In the future, we can expect even more advanced ADAS systems that can take over more aspects of driving, making the road safer and more efficient.

Overall, the future of HMI for automobiles is promising, with new technologies and designs promising to make the driving experience safer, more efficient, and more enjoyable. As technology continues to advance, we can expect to see even more exciting developments in this field.

Reference

1.) "A Survey of Human-Machine Interface Design for Autonomous Vehicles" by Di Zhao et al. (2018)

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3.) "Design of a Human-Machine Interface for Driver Monitoring System in Automotive Applications" by Rodrigo Pereira et al. (2021)

4.) "A Comparative Study on User Interfaces of Automotive Human-Machine Interaction for Electric Vehicles" by Xinzhe Liu et al. (2021)

5.) "Visual Attention Guidance for Intelligent Vehicles: A Survey" by Jianming Hu et al. (2021)

6.) "A Framework for Adaptive Automotive Human-Machine Interaction" by Julian Schilling et al. (2020)

7.) "Human-Machine Interface Design for Autonomous Vehicle: A Systematic Review" by Xiaoyu Wang et al. (2021)

8.) "Multi-Modal Human-Machine Interaction Design for Highly Automated Driving" by Jie Chen et al. (2018)

9.) "Human-Machine Interface in Autonomous Driving: A Systematic Review" by Nanxiang Li et al. (2019)

10.) "Design and Evaluation of a Human–Machine Interface for Semi-Automated Driving" by Fabian Will et al. (2020)

11.) "Development of a Human-Machine Interface for an Autonomous Mobile Robot" by Wei Hu et al. (2021)

12.) "Design and Evaluation of a Human-Machine Interface for Navigation in Virtual Reality" by Vincenzo Scopelliti et al. (2021)

13.) "Design and Evaluation of a Human-Machine Interface for an Intelligent Home Automation System" by Muhammad Awais et al. (2021)

14.) "A Human-Machine Interface Design for a Mobile Robot" by Ryohei Ikeura et al. (2020)

15.) "Intelligent Human-Machine Interface Design for Industrial Robots" by Li Li et al. (2021)