International Journal of Research Publication and Reviews

Smart Garage System: Mobile App-Controlled Security with Sensors

S. Malaravan , A. Keerthivasan , K. Balaji

Computer Science and Engineering, UG students, Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala College of Engineering, Avadi

ABSTRACT :

The Internet of Things (IoT) has revolutionized home automation, allowing users to control appliances remotely. This paper explores the integration of IoT in smart home systems, focusing on the popular application of smart garage doors. By utilizing network protocol and IoT sensors, homeowners can operate their garage doors from anywhere using a mobile app. This enhances security and convenience while reducing manual handling. However, previous literature highlights challenges of high development costs and power consumption. This paper aims to propose cost-effective and energy-efficient solutions for smart garage systems, addressing these limitations and promoting wider implementation.

Keywords : Internet of Things, Smart home systems, Smart garage doors, Remote control, Mobile app, IoT sensors, Security, Convenience, Cost-effective, Energy -efficient.

Introduction :

The Internet of Things (IoT) has emerged as a transformative and disruptive technology in cloud computing, revolutionizing various systems and applications across different domains, including the realm of smart home systems. The concept of a smart home entails leveraging network technology to automate home appliances, enabling users to accomplish tasks with minimal human intervention even before they arrive home [1, 2]. The development of smart homes has facilitated remote interfaces for controlling and monitoring home devices through networking technologies such as wireless transmission, the internet, and mobile apps [3, 4]. Furthermore, research indicates that smart home systems not only enhance energy efficiency but also improve overall quality of life [5, 6].

The rise of smart homes has coincided with the increasing popularity of the Internet of Things (IoT), which refers to the integration of everyday household objects, including home accessories, houses, and garage doors, into the networked ecosystem [8, 9]. The application of IoT in the context of smart homes has notably contributed to better security systems and enhanced convenience for homeowners. Among the various IoT applications within smart home projects, the smart garage door system has gained significant traction [10-12]. This system development serves to heighten safety and convenience for residents, allowing remote door operation through network protocols and IoT sensors [13, 14]. By utilizing a mobile app installed on smartphones, users can access and control their garages from anywhere, streamlining the process and reducing the need for manual intervention. This not only prevents unauthorized access but also minimizes the manual effort required to open and close the garage door. Additionally, the integration of IoT sensors enables owners to have full control over their garage doors using smartphones, irrespective of their location [16]

Literature Review:

a. Garage Door System :

The utilization of IoT technology in securing residential buildings through smart garage doors has gained popularity in recent years. IoT technology has significantly enhanced the security measures, safety, and usability of garage doors. The integration of IoT technology into garage doors offers several advantages, as highlighted in previous literature. These advantages include the ability to remotely open and close garage doors from any location, increased security by allowing only authorized residents to access the premises, and the activation of car capacity mode, which deactivates when the garage door is left open for an extended period.

However, despite these benefits, there are two major drawbacks or concerns associated with the implementation of IoT technology in garage doors, as reported in the literature. The first concern pertains to network vulnerabilities, where unauthorized individuals may exploit the network to gain access to the premises. The second concern relates to security and privacy issues, as garage door owners may not be aware of potential errors or malfunctions while the doors are open or closed, such as doors failing to close properly.

Considering the aforementioned limitations, the implementation of Smart Garage systems necessitates improved design and development efforts to address these concerns effectively.

b.   Current Issues and Proposed Solution :

The existing literature emphasizes the importance of developing intelligent garage door systems to enhance the comfort, safety, security, and efficiency of residents. These systems are integral components of smart home setups, allowing control via internet connectivity, typically through mobile phone applications. However, several issues have been identified regarding the usage, design, development costs, and implementation of intelligent garage door systems. Notably, the implementation of smart garage doors often incurs high design and development expenses. Furthermore, the dynamic nature of IoT development has presented challenges related to integrating users' home devices, managing implementation costs, and addressing discrepancies among different IoT device types, resulting in user inconvenience.

To address these concerns, this research project proposes a novel and cost-effective prototype solution for designing and developing smart garage doors. The project aims to develop an intelligent garage door system based on an accessible Android smartphone platform, utilizing a user-friendly mobile application. The core objective is to design and develop an Android mobile application that allows users to conveniently open and close their garage doors using Wi-Fi, 3G, or 4G connectivity. The mobile app will also incorporate Google Assistant functionality, enabling users to utilize voice commands to control the garage door. The subsequent section outlines the methodology employed in this research project, providing brief explanations of each phase. This is followed by the Results and Discussion section, which highlights and elaborates on the relevant tests conducted. Finally, a concise summary of the research project's conclusions and future directions will be presented.

Methodology:

Materials and Modules

Garage Door Opener :

 A motorized apparatus that effortlessly raises and lowers the garage door, offering convenience and ease of use. This can encompass a traditional door opener or an advanced smart-enabled alternative.

Sensory Array :

 An assemblage of diverse sensors employed to discern the garage door's status and monitor its environs. These may encompass:

Door Position Sensor: Determines whether the door stands open or closed.

Motion Sensor: Detects any movements within the garage vicinity.

Proximity Sensor: Identifies the presence of objects or vehicles in close proximity to the garage door.

Light Sensor: Measures the ambient light levels within the garage.

Central Control Panel :

 Serving as the core hub, the control panel orchestrates the management of the intelligent garage system. It gathers inputs from sensors and the mobile app, meticulously regulating the garage door's operation.

Internet Connectivity :

Seamless integration with the online realm is indispensable for remote control and monitoring of the smart garage system. It harnesses either Wi-Fi or cellular networks (such as 3G or 4G) to communicate with the mobile app.

Mobile Application :

 An exclusive mobile app forms the crux of managing and overseeing the smart garage system. Empowering users with remote control, it bestows the ability to open or close the garage door remotely, receive real-time updates on its status, and administer security settings. Typically tailored for smartphones and tablets.

Fortified Security Features :

 Augmenting security measures, supplementary components can be incorporated, comprising:

User Authentication: Employing secure login credentials or biometric authentication to thwart unauthorized access to the mobile app.

 Activity Logs: Recording and presenting a comprehensive log of garage door activities, encompassing opening/closing instances and sensor triggers.

Alerts and Notifications: Promptly disseminating real-time notifications to the user's mobile device, promptly relaying any security breaches or unusual occurrences.

Seamless Smart Home Integration :

The smart garage system seamlessly integrates with other smart home devices and platforms, enabling seamless control and automation. This encompasses harmonizing with voice assistants, smart locks, and security systems.

Software Development Kit (SDK) :

An SDK provides the necessary tools, libraries, and resources for developing mobile applications. It includes programming languages, development environments, and APIs specific to the target platform (e.g., Android or iOS).

Integrated Development Environment (IDE) :

An IDE is a software application that provides a comprehensive environment for app development. It includes features like code editors, debuggers, and emulators to streamline the development process.

Programming Languages :

Depending on the platform, programming languages such as Java or Kotlin for Android and Swift or Objective-C for iOS are used to write the code for the mobile app.

User Interface (UI) Design Tools :

Tools like Adobe XD, Sketch, or Figma are used to create visually appealing and user-friendly app interfaces. They enable designers to create wireframes, prototypes, and UI assets.

Backend Development :

For apps that require server-side functionality or database integration, backend technologies like Node.js, Ruby on Rails, or Django may be used. These frameworks help manage data, handle user authentication, and facilitate communication between the app and server.

Application Programming Interfaces (APIs) :

APIs allow the mobile app to interact with external services and devices. In the case of a smart garage system, APIs may be used to communicate with the garage door opener, sensor devices, or other smart home devices.

Database Management Systems :

If the app requires data storage, database management systems like MySQL, MongoDB, or Firebase can be used to store and retrieve information.

**Testing and Debugging Tools :**

Tools like Android Studio or Xcode provide features for testing and debugging mobile apps. They enable developers to identify and fix issues, optimize performance, and ensure compatibility across different devices.
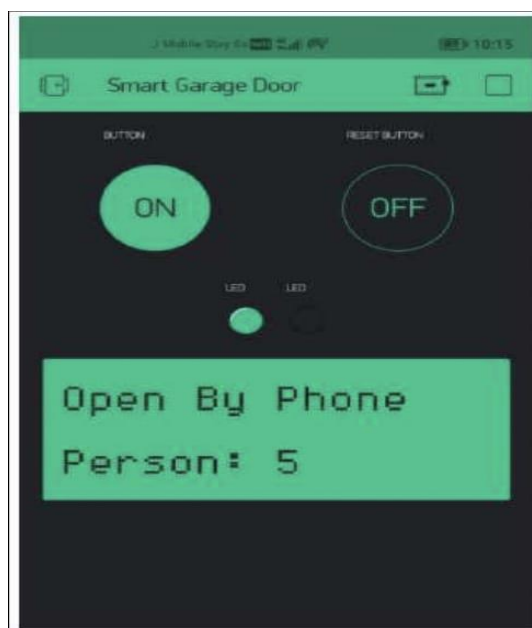
Version Control Systems :

Version control systems like Git are used to manage source code, enabling multiple developers to collaborate, track changes, and maintain different app versions.

Deployment Platforms :

App stores like Google Play Store or Apple App Store provide platforms for distributing and publishing the mobile app to users.

Block Diagram :
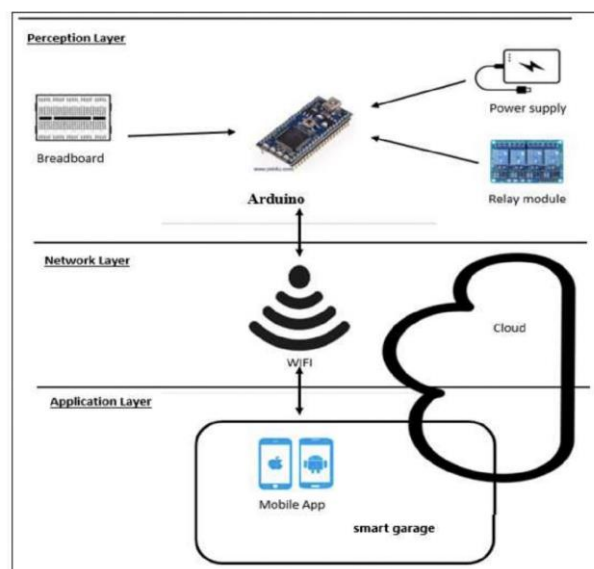
Result :

Conclusion :

The Smart Garage System, with its mobile app-controlled security and sensors, has revolutionized garage interaction. Seamlessly integrating openers, sensors, and a sleek mobile app, users gain effortless control from anywhere. Sensor-based security and real-time notifications ensure unauthorized access is thwarted. The intuitive app, powered by advanced software and elegant design, empowers users with seamless control. Back-end integration and robust testing guarantee flawless performance. Embrace this technological marvel, redefine your garage experience, and elevate your lifestyle with convenience, security, and efficiency.

References :

1) R. L. Cheu and O. Gurbuz, "Sparkman: A Smart Parking Management Tool for University Campuses," C2SMART Center. 2020.

2) V. Paidi, H. Fleyeh, J. Håkansson and R. G. Nyberg, "Smart parking sensors, technologies and applications for open parking lots: a review," IET Intelligent Transport Systems, 12(8), 735-741. 2018.

3) A. Elsonbaty, "The smart parking management system," Int. Jr. of Computer Science & Information Technology, 12(4). 2020.

4) J. J. Barriga, J. Sulca, J. L. León, A. Ulloa, D. Portero, R. Andrade and S. G. Yoo, "Smart parking: a literature review from the technological perspective," Applied Sciences, 9(21), 4569. 2019.

5) IPMI, "2018 emerging trends in parking," International Parking & Mobility Institute. 2018.

6) W. He, J. Martinez, R. Padhi, L. Zhang, and B. Ur, "When smart devices are stupid: negative experiences using home smart devices," in 2019 IEEE Security and Privacy Workshops (SPW), 2019: IEEE, pp. 150-155. 2. E. Alihodzic and E. Sokic, "Development of a Wi-Fi based car gate remote control and 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 1 2 3 4 5 http://www.webology.org supervision system," in 2020 28th Telecommunications Forum (TELFOR), 2020: IEEE, pp. 1-4.

7) AfazUddinAhmed ,Taufiq Mahmud Masum ,Mohammad Mahbubur Rahman ,"Design of an Automated Secure Garage System", http://www.mecspress.org/ijisa/ijisa-v6- n2/IJISA-V6-N2-3.pdf,jan 2014.

8) Gyanendra K Verma and PawanTripathi ,"A Digital Security System with Door Lock System Using RFID Technology", http://www.ijcaonline.org/volume5/number11/pxc387133 4.pdf, Aug 2010.

9) M. S. Hossain, M. Rahman, M. T. Sarker, M. E. Haque, and A. Jahid, "A smart IoT based system for monitoring and controlling the sub-station equipment," Internet of things, vol. 7, p. 100085, 2019.

10) T. Alam, A. A. Salem, A. O. Alsharif, and A. M. Alhejaili, "Smart home automation towards the development of smart cities," APTIKOM Journal on Computer Science and Information Technologies, vol. 5, no. 1, pp. 152-159, 2020.