PIEZO SMART DOOR MAT

Dr. Dinesh Kumar D S[1], Sulagna Mondal[2], Thanushree M.K[3], V.Likhith[4], Tirumala Ganesh[5]

Associate professor, Department of ECE, K.S Institute of Technology, BENGALURU, INDIA[1]

Electronics and Communication Engineering, K.S Institute of Technology, BENGALURU, INDIA[2-5]

Abstract: This paper presents the development and implementation of a smart door mat utilizing face recognition technology. The primary goal of this project is to enhance improving accessibility for users, offering a hands-free entry solution, and strengthening home security by logging visitor data. The project emphasizes usability, reliability, and scalability, making it suitable for residential and commercial applications. The system integrates a face recognition algorithm implemented in Python using the OpenCV library, with adjustments controlled by an Arduino through serial communication.

Keywords: Piezoelectric Sensor, Smart Doormat, Visitor Detection, Home Automation, IoT Integration, Energy Efficiency

I. INTRODUCTION

In our daily lives, safety is a major concern. Every person requires a sense of safety. Our security pattern includes an access control system for doors. Traditional locks are no longer as secure as they once were; anyone can gain access by breaking these locks. We need to create a system that will assist 24 hours a day, seven days a week. Only authorized individuals have access to restricted areas thanks to a smart door mat. The Piezo Smart Door Mat is a patented new technique aimed at improving the safety and safeguarding a home. In order to develop a fully effective automated solution, the Smart Mat is able to register the user's footstep and perform a pre-programmed function such as unlocking the door and taking a picture of the person standing in front of the door. The Piezo Smart Door Mat On the other hand, is capable of contacting the specified group of individuals and is beneficial in contactless means of opening a door. The idea revolving this product is that as an image of an individual is captured, it is compared via the network database of authorized members on the server. If a match is made through the aided image capture the door will seamlessly open without any need to touch the door Such technology alongside the usage of advanced AI means further upgrades are bound to revolutionize doors in a smart house or office by the Piezo Smart Door Mat Then again the Piezo Smart Door Mat has a very fundamental goal of helping the doors of a house or an office to speak or communicate for better contactless interactions. Making sure that the security and the protection of your loved ones and operations within a commercial center are as smooth as ever implemented.

II. LITERATURE PAPER

[1]   **Genta Yuandhana et al. (2021)**: In their study "Piezoelectric Mat as Door Bell," the authors explored the use of piezoelectric sensors to generate electricity and detect visitor presence. This work emphasized the dual functionality of energy harvesting and security, laying the foundation for integrating piezoelectric technology into home automation systems.

[2]   **Vinit Janbandhu et al. (2016)**: The paper "Design and Implementation of Smart Door Mat" presented a system for energy harvesting using piezoelectric sensors. This study highlighted the potential of using human footsteps to generate power, which could then drive small electronic devices. It also introduced the concept of integrating these systems into environments like staircases and parking lots.

[3]   **Renuka Kshirsagar et al. (2023)**: In their paper "IoT-Based Visitor Sensing Smart Doormat," the authors introduced an IoT-enabled doormat capable of capturing visitor data and sending notifications to the homeowner. The integration of cloud-based systems with piezoelectric sensors demonstrated a novel application for smart home security, significantly enhancing user convenience.

[4]   **Tannu Mate et al. (2023)**: This study, "Piezo-Based Visitor Sensing Welcome Mat," provided insights into the practical implementation of piezoelectric sensors for visitor detection. It emphasized user-friendly design and ease of installation, making the system accessible to a wide range of users. The paper also explored customization options, such as programmable audio and visual notifications.

[5] **Mohan K. Mallikarjun et al. (2022)**: The paper "Piezoelectric Door Mat" discussed energy generation through piezoelectric sensors placed in high-traffic areas. It highlighted the ability to power LED indicators and other small devices, showcasing the durability and scalability of piezoelectric systems in different environments.

[6] **Anunay Kumar et al. (2021)**: Their work on "IoT-Based Visitor Sensing Doormat" integrated home automation with security. The study demonstrated the potential of real-time visitor alerts and seamless interaction with other smart home devices. It highlighted challenges such as internet dependency and proposed solutions for robust system performance.

[7] **Prof. M.D. Nikose et al. (2017)**: The "SMART MAT - People Counting Information" paper explored the use of pressure sensors for real-time people counting. Although focused on crowd management, the findings are relevant for designing systems that detect foot pressure and provide analytics.
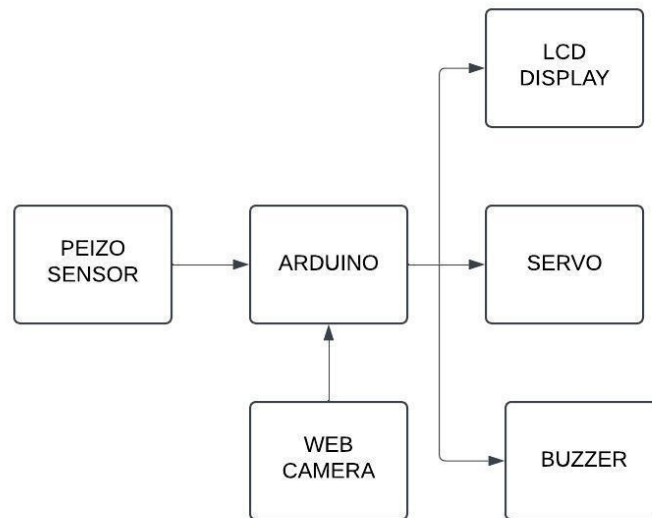
III. METHODOLOGY

A. BLOCK DIAGRAM

Figure 1 The block diagram represents the interconnected components of the Piezo-Based Visitor Sensing Welcome Mat system. At its core, piezoelectric sensors detect foot pressure and generate electrical signals that are processed by an Arduino Uno microcontroller. The Arduino then triggers outputs such as LEDs for visual alerts, a buzzer for auditory notifications, and a camera for image capture. The power source supports the system's operation, while an optional IoT module enables remote monitoring and control, ensuring a seamless and efficient visitor sensing experience.

B. WORKING

When a visitor steps on the mat, the piezoelectric sensors embedded within it detect the applied pressure and convert it into an electrical signal. This signal is then transmitted to the Arduino Uno microcontroller, which acts as the brain of the system. Based on pre-programmed instructions, the Arduino processes the signal and activates connected output devices such as LEDs, a buzzer, or a camera. The LEDs provide visual feedback, the buzzer emits an audible alert, and the camera captures images of the visitor. For systems integrated with IoT, the data is transmitted to a cloud platform or sent as notifications to the homeowner, enabling real-time monitoring and data logging. This comprehensive workflow ensures seamless and efficient operation, enhancing both security and convenience.
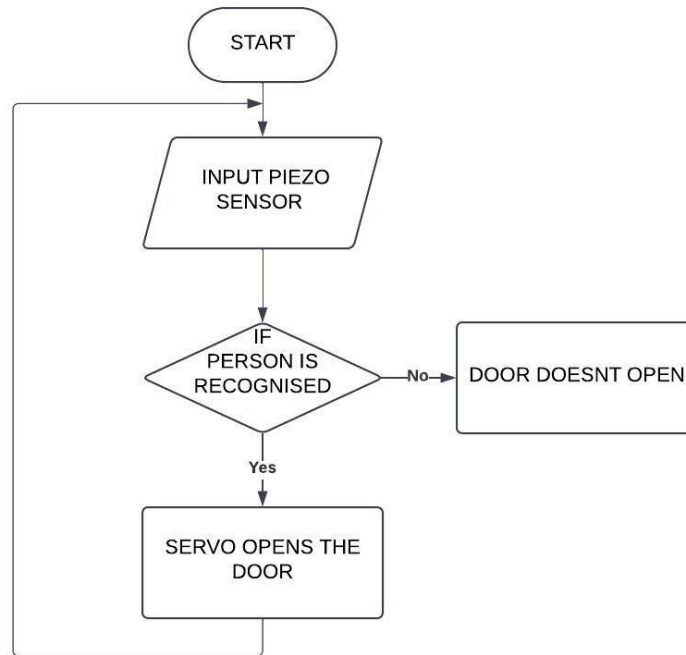
C. FLOWCHART

Figure 2 The flowchart outlines the step-by-step operation of the Piezo-Based Visitor Sensing Welcome Mat. Initially, the system detects pressure through the piezoelectric sensor when a visitor steps on the mat. This pressure generates an electrical signal, which is processed by the Arduino microcontroller. Based on the processed signal, predefined responses are triggered—such as illuminating LEDs for visual feedback, sounding a buzzer for auditory alerts, or capturing the visitor's image using the camera. For IoT-enabled setups, the system transmits data to a cloud platform or sends notifications to the homeowner's device, enabling real-time monitoring. This structured sequence ensures efficient and seamless visitor detection and response.
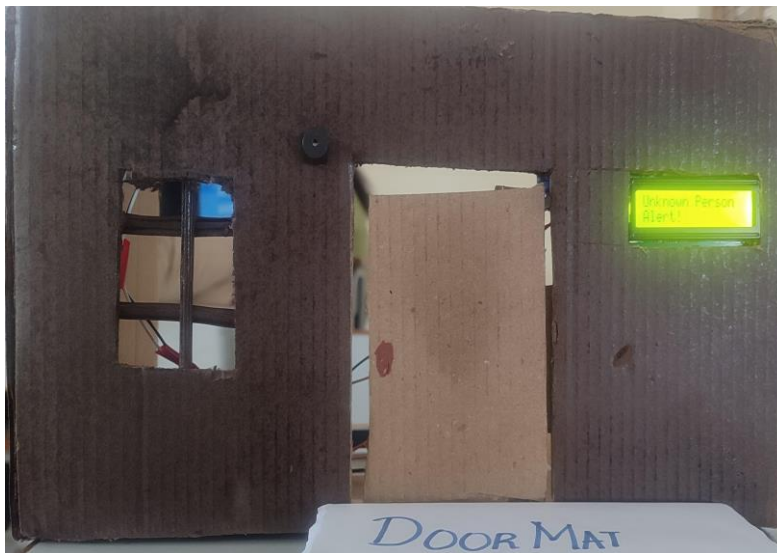
IV. RESULTS

The prototype of the proposed system is shown in Figure 3

Case 1: When the authorized person stands on the door mat, the visitor is recognized via camera module and the door opens automatically.

Case 2: When an unknown person steps on the door mat the buzzer beeps alerting that the visitor is unknown.

V. APPLICATIONS

1. **Home Security:** Enhances residential security with real-time detection and notification.
2. **Commercial Use:** Efficient visitor management in offices, hotels, and retail spaces.
3. **Healthcare:** Monitors patient movements in hospitals and clinics.
4. **Industrial:** Tracks employee and visitor activity for security and analytics.
5. **Public Spaces:** Manages foot traffic at events or crowded areas.
.

REFERENCES

[1]. Genta Yuandhana et al., "Piezoelectric Mat as Door Bell," Indonesian Journal of Multidisciplinary Research, 2021.
[2]. Vinit Janbandhu et al., "Design and Implementation of Smart Door Mat," International Journal for Scientific Research & Development, 2016.
[3]. Renuka Kshirsagar et al., "IoT-Based Visitor Sensing Smart Doormat," International Journal of Advanced Research in Science, Communication and Technology, 2023.
[4]. Tannu Mate et al., "Piezo-Based Visitor Sensing Welcome Mat," International Journal of Advanced Innovative Technology in Engineering, 2023.
[5]. Mohan K. Mallikarjun et al., "Piezoelectric Door Mat," International Journal of Scientific Research in Computer Science, Engineering and Information Technology, 2022.

[6]. Anunay Kumar et al., "IoT-Based Visitor Sensing Doormat," Future Generation, 2021.

[7]. Prof. M.D. Nikose et al., "SMART MAT - People Counting Information," 2017.

[8]. Vivek R, Gokul Shyam D, Jai Adithya R, Nihal V. (2024) A Detailed Review on Fingerprint Based Door Lock System.

[9]. Prof. M.D. Nikose, Aishwarya Nagare, Nikita Naikwadi, Sonali Satalkar (2017) SMART MAT People Counting Information

[10]. Kanigiri Anusha, Cheetriala Kiranmai, Mula Bhargavi priya, Mula Yamini B.(2020) Biometric Based Security Authentication For Bank Locker System

[11]. MohammadAsadul Hoque(2019) IoT-Based Smart Home Security Application