Intelligent Automation of Garment Folding and Ironing Using Servo-Actuated Robotics

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***Abstract*—The Automatic Garment Folding and Ironing Machine is an embedded system aimed at simplifying and automating the tedious task of folding and ironing clothes. The system employs an innovative robotic mechanism to deliver efficient and consistent performance.The system allows users to load freshly laundered garments, after which the folding and ironing processes are performed autonomously. The primary objectives of the project are to save users time and effort, eliminate the need for manual intervention, and ensure wrinkle-free and neatly folded clothes. Through the implementation of this solution, individuals can experience a significant improvement in their laundry routine, promoting convenience and productivity in everyday life. The project's pen-source nature allows for customization and expansion, encouraging collaboration and innovation in the field of home automation.**

***Index Terms*—Garment Folding, Servo Actuated Motors, Arduino**

I. INTRODUCTION

In today's fast-paced environment, repetitive household tasks such as folding and ironing garments demand considerable time and effort, motivating the need for intelligent automation. The Automatic Garment Folding and Ironing Machine addresses this challenge by integrating robotics to detect garment dimensions, apply optimized folding patterns, and deliver consistent, wrinkle-free results. Its design emphasizes simplicity and efficiency, enabling a hands-free solution that enhances convenience in daily life. Beyond core functionality, the system highlights affordability and accessibility by utilizing cost-effective components and a user-friendly assembly process. In addition, its open-source framework fosters community-driven customization and continuous performance improvement. By transforming a labor-intensive process into an automated routine, this work demonstrates the potential of collaborative innovation to advance home automation and improve overall quality of life. Objectives of the study are given below

- Automation and Efficiency – Reduce manual effort and save time by automating garment folding and ironing.
- Consistency and Quality – Deliver wrinkle-free, neatly folded garments with reliable computer vision and machine learning techniques.
- Affordability and Accessibility – Use low-cost, readily available components to ensure wide usability.
- User-friendly Design – Provide simple assembly, easy operation, and straightforward maintenance for everyday users.

The remainder of this paper is organized as follows: Section II reviews related works, Section III details the system design, Section IV presents experimental results, and Section V concludes with future directions

II. LITERATURE REVIEW

Prior research in garment care automation has focused on both ironing and folding tasks. The study "Design and Research on Intelligent Ironing Machine" [1] explored the structural design and control principles of an intelligent ironing system that integrates human–computer interaction. The system demonstrated the ability to autonomously select optimal ironing strategies, thereby balancing efficiency with garment quality. By achieving one-click ironing functionality, this work highlighted how intelligent control can save time and enhance convenience in modern lifestyles. Complementing this direction, "Folding Clothes Autonomously: A Complete Pipeline [2] presented a

comprehensive framework for robotic garment folding using a dual-armed robot. Their approach addressed all key subtasks in handling garments, including isolating a single item from a pile, recognizing garment type, unfolding, spreading, and executing a series of folding moves. Novel contributions included methods for garment isolation and spreading, which, together with earlier work on unfolding and folding, resulted in a complete end-to-end pipeline for autonomous clothes folding. Collectively, these studies emphasize the growing feasibility of intelligent systems that can automate traditionally labor-intensive garment handling processes. The automation of garment folding and ironing has attracted increasing attention due to the potential to reduce manual labor and improve consistency in clothing care. Other contributions, such as ironing support systems with superimposed guidance information [3], focus on enhancing human interaction, particularly for beginners, showing that user-assisted automation can complement fully autonomous systems by reducing errors and learning curves. This study in [4] presents the design and development of an automatic Clothes Folding Machine aimed at assisting users who lack time for household chores, especially working men and women. The proposed system, built using components such as Arduino and servo motors, provides a cost-effective and user-friendly solution that folds clothes automatically within seconds, thereby saving time, effort, and energy. Foundational hardware components play a significant role in system feasibility: the Arduino Nano [5] provides a compact and flexible microcontroller platform capable of orchestrating multiple actuators, while high-torque servo motors [6] enable precise manipulation required for folding and ironing tasks. Overall, these studies collectively underscore the importance of a balanced design that considers mechanical robustness, control accuracy, user interaction, and cost-effectiveness. This convergence provides a roadmap for developing holistic solutions capable of automating garment folding and ironing in domestic and commercial settings.

III. PROPOSED SYSTEM WORKING

One such chore is cloth folding and ironing, a monotonous task that demands precious hours of our daily routine. The Automatic Garment Folding and Ironing Machine is an ambitious project that aims to provide an innovative solution to a seemingly mundane task. By employing readily available components like Arduino Nano, MG995 servo motors, and heating elements, the machine demonstrates its accessibility and affordability. The selection of the hardware is very important in the existence and proper working of any of the software. When selecting hardware, the size and the capacity requirement are also important. The system developed using the following hardware components.

- Arduino Nano
- MG995 Servo Motors (5x) - High torque servo motors for folding and ironing movements.
- Jumper Wires - Male-to-male and male-to-female jumper wires for connecting components.
- DC-DC Buck Converter LM 2596 - To step down the voltage from 12V to 5V for the Arduino Nano and servo motors.
- Power Supply - 12V, 5A power supply for powering the cartridge heaters and other components.
- Heating and Ironing Components:
- Cartridge Heaters (3x) - 12V, 40W cartridge heaters for the ironing pad.
- Switch - push switch
- Dot board -70mm*70mm
- Generic connection wires
- Ironing Pad Material - A heat-resistant pad or cloth to place beneath the shirt during ironing. 6. Mechanical Components:
- Clothes Folding Board - Pre-made folding board or DIY version made from sturdy material.

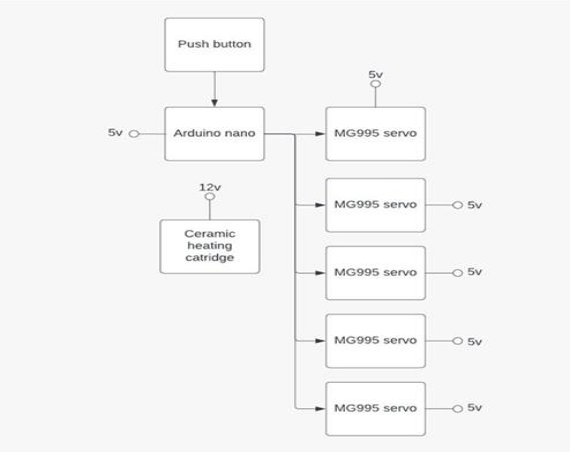

Fig 1 illustrates the block diagram of the proposed system

The system operation begins with the initialization and setup phase, where the Arduino Nano is powered via a DC-DC buck converter that steps down the input voltage to 5 V, suitable for the microcontroller and the MG995 servo motors. The servo motors are connected to the Arduino using jumper wires and strategically positioned to facilitate both folding and ironing movements. User interaction is provided through a push switch, which powers on the system and enables it to receive garment folding and ironing commands. For the folding process, the user places the garment on the clothes folding board in the correct orientation. Upon receiving the command via the push switch, the Arduino activates the servo motors, which manipulate the folding arms to fold the garment according to pre-programmed patterns. Once folding is complete, the ironing setup is prepared by placing a heat-resistant ironing pad on a flat surface, with three 12 V, 40 W cartridge heaters positioned beneath it. The Arduino controls the power supply to the heaters through a relay or MOSFET module, regulating the temperature as required. During ironing, the folded garment is placed on the heated pad, and the system smooths out wrinkles by maintaining controlled heat and pressure. After the ironing process, the system is powered down using the push switch, allowing the user to remove a neatly folded and ironed garment. Each step is coordinated by the Arduino Nano to ensure precise and efficient operation of the folding and ironing tasks. Figure 3 shows the prototype of the developed system.

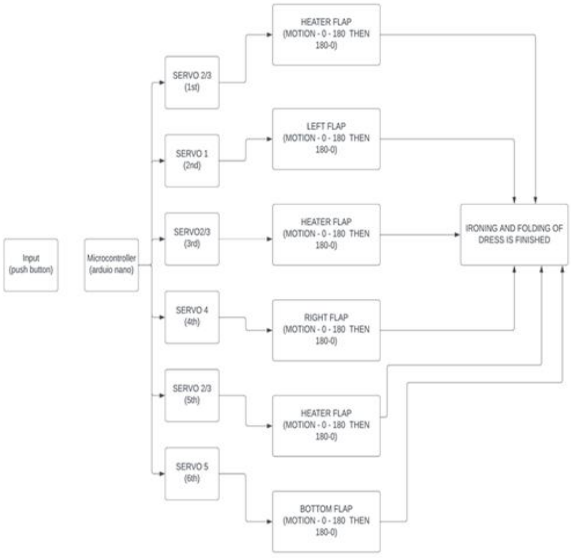

Fig 2 depicts a detailed view of the proposed system.

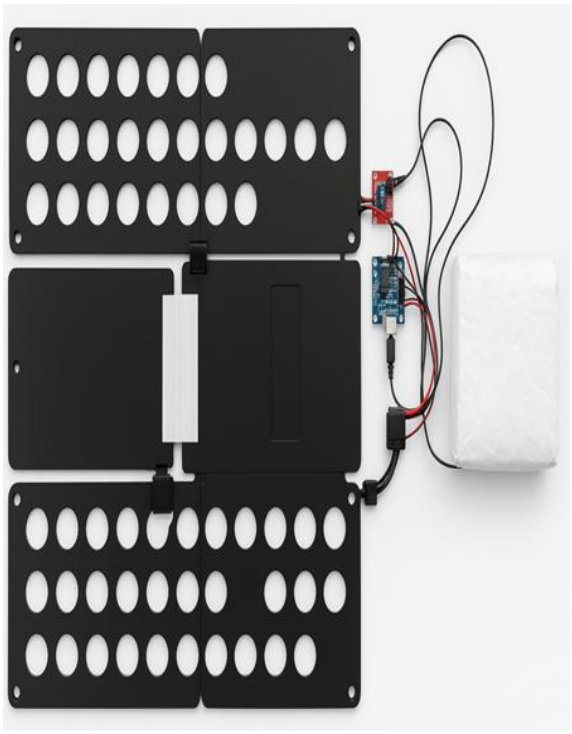

Fig 3 illustrates the prototype of the proposed system

IV. CONCLUSION

The Automatic Garment Folding and Ironing Machine presents an innovative and practical solution for automating the time-consuming tasks of garment folding and ironing. By integrating robotics, servo motors, and pre-programmed control mechanisms, the system demonstrates significant improvements in efficiency, consistency, and convenience compared to traditional manual methods. The machine ensures neatly folded and wrinkle-free garments, providing results comparable to professional services while remaining accessible and cost-effective for households and small businesses. The project also highlights the potential for customization and community collaboration through its open-source approach, allowing users to modify and enhance the system according to specific requirements. While the system achieves reliable performance, certain challenges remain, including precise servo calibration, temperature control for ironing, and safety considerations associated with heating elements. Future improvements could focus on incorporating fail-safe mechanisms, energy-efficient features, and commercial scalability.

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