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Sign Language Translator

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Abstract: The Sign Language Translator Glove is an assistive wearable system designed to bridge the communication gap between speech- and hearing-impaired individuals and the general public. The system uses six flex sensors, three placed on each hand, to measure finger-bending patterns. These analog signals are converted into numerical values through an Arduino Mega microcontroller. Each sensor reading is compared against predefined thresholds to map finger states to specific gestures. The Arduino processes these patterns and displays the recognized gesture on an OLED screen. When a valid gesture is confirmed, the system outputs the corresponding text and audio message, enabling real-time gesture-to-text and speech translation.

Keywords: Sign Language Translator, Flex Sensors, Arduino Mega, Gesture Recognition, Assistive Technology.

I.INTRODUCTION

Communication plays a vital role in human interaction, but for millions of speech- and hearing-impaired individuals, conventional communication through spoken language is a major challenge. Sign language is their primary medium, yet the general public's unfamiliarity with it creates a significant barrier. Advancements in sensor technology and microcontrollers have opened opportunities for low-cost assistive devices.

Smart gloves equipped with flex sensors are practical for capturing hand gestures. Unlike camera-based systems that require stable lighting and high processing power, flex-sensor gloves are portable, easy to use, and offer a direct physical interface. This project provides a user-friendly solution that converts selected hand gestures into meaningful text and audio outputs in real time.

II.METHODOLOGY

The methodology involves capturing hand gestures using flex sensors, processing the data through an Arduino Mega, and translating recognized gestures into corresponding visual and audio outputs.

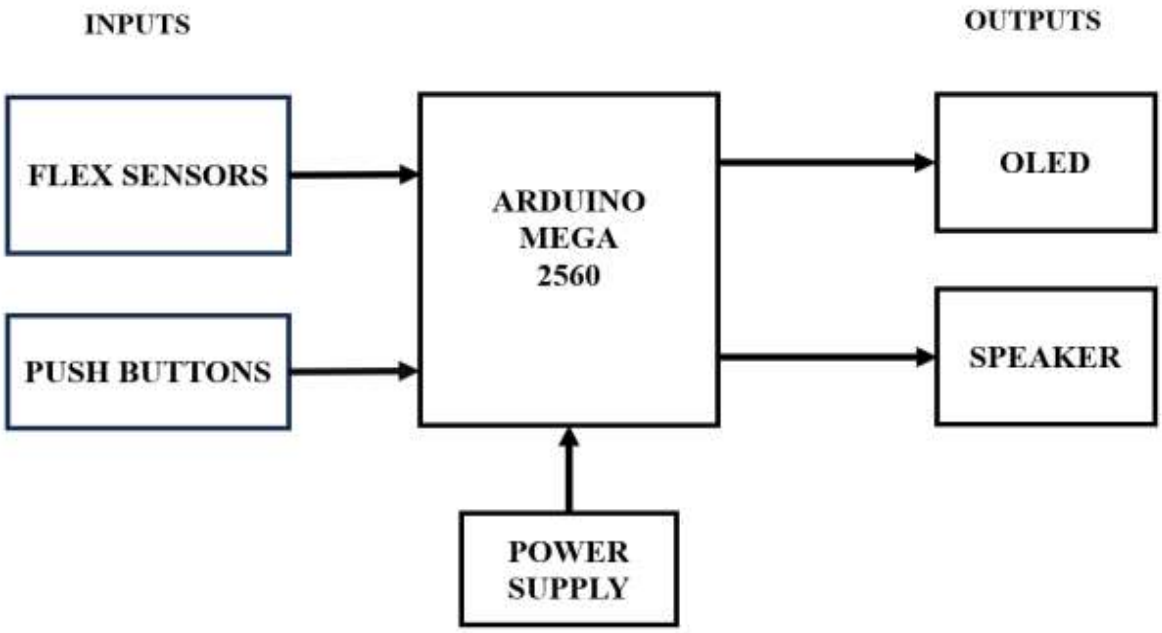

Fig. 1 Block diagram of sign language translator

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A. Hardware Integration

The glove is fitted with six flex sensors, separated into two groups of three (S1-S3 and S4-S6) to detect finger bending. Each sensor produces an analog voltage read by the Arduino Mega. An SSD1306 OLED display is interfaced via I2C, and a speaker is connected to a digital output pin for audio generation. Two push buttons are used: START/STOP to begin or end recording, and CLEAR to remove the last recorded letter.

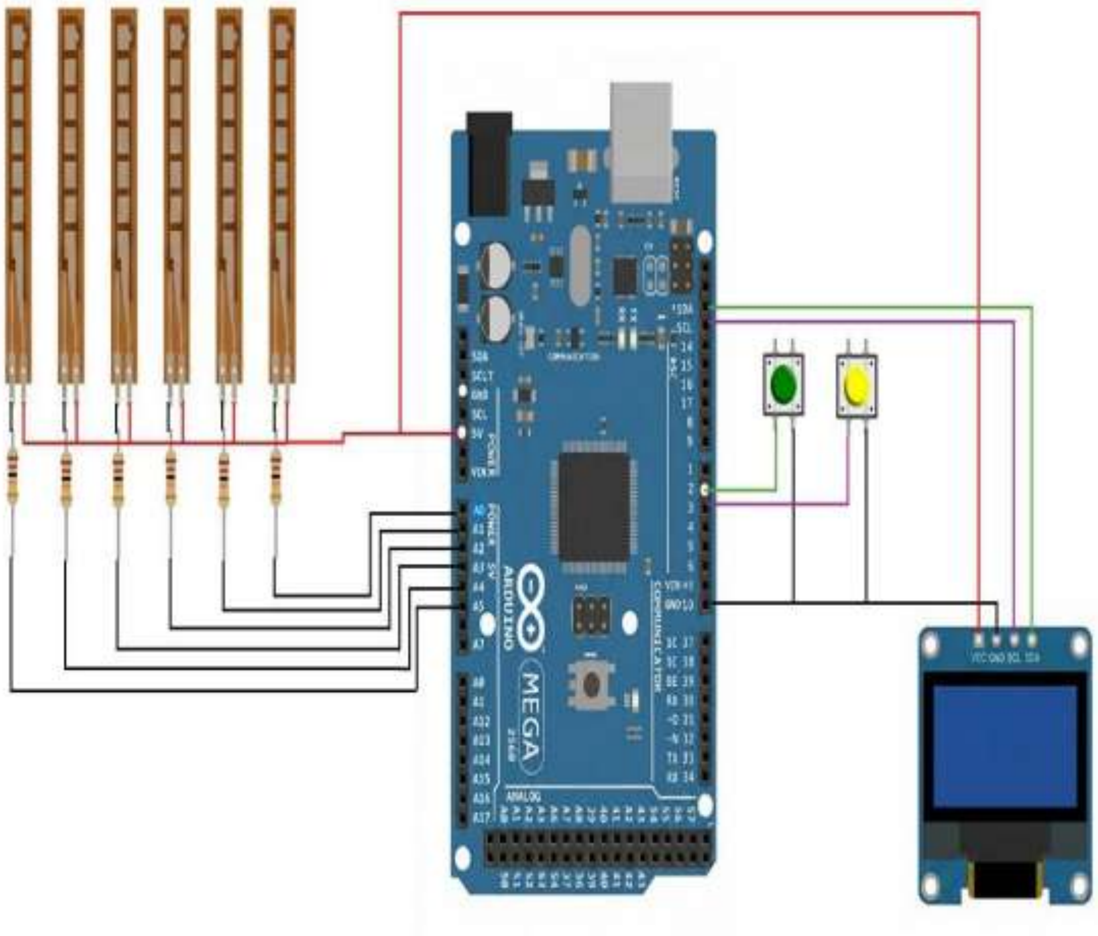

Fig. 2 Schematic diagram

B. Software and Algorithms

To ensure high accuracy during gesture recognition, the software implements a continuous sampling loop executing at approximately 50 iterations per second. The moving average filter maintains a dedicated history buffer for each of the six flex sensors, continuously updating the sum and calculating the mean to smooth out transient electrical noise or slight hand tremors. Furthermore, the hysteresis band prevents rapid toggling between logical states when a sensor's analog value hovers near a specific threshold, thereby providing a clean, stable binary signal for the downstream classification logic.

Once the filtered signals are obtained, the classification algorithm maps the binary states of the first sensor group (S1–S3) and the second sensor group (S4–S6) to their corresponding characters. If a specific sensor combination does not match any predefined gesture signature, the system assigns an 'unknown' state to prevent erroneous text generation. A dedicated stability counter strictly requires the recognized gesture pair to remain constant for a specific duration—typically around 200 milliseconds—before the system registers the character as an intentional input and appends it to the active word buffer. Additionally, the software incorporates robust debounce logic for the physical push buttons, ensuring that 'clear' or 'start/stop' commands execute exactly once per user press without false triggers.

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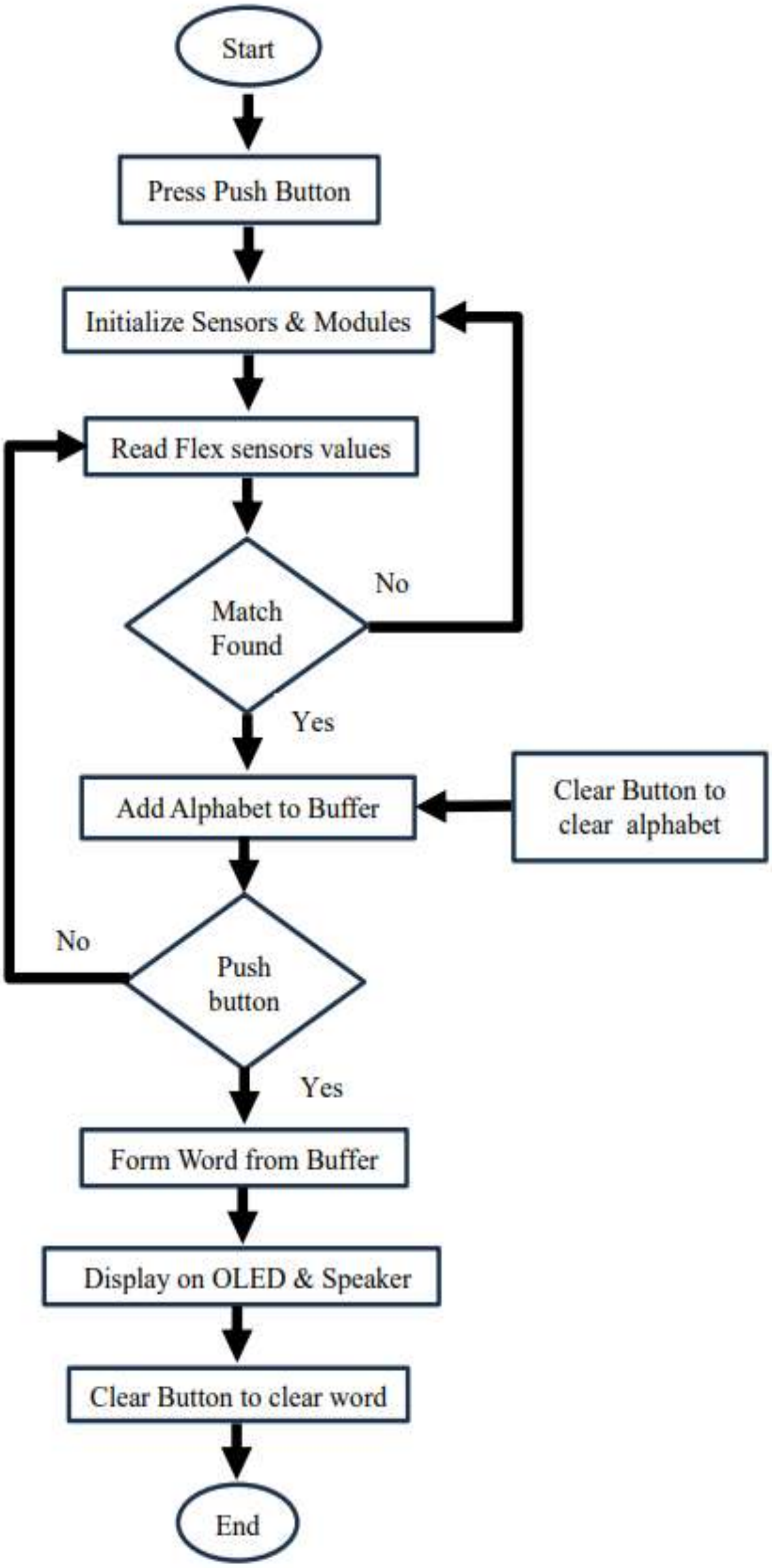

Fig. 3 Flow diagram of sign language translator

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III.HARDWARE DESCRIPTION

A. Arduino Mega 2560 The Arduino Mega functions as the main control unit, interfacing with the flex sensors and buttons to detect gestures. Its compact size and multiple analog inputs make it ideal for wearable applications.

B. Flex Sensors Working on the principle of resistive variation, the flex sensor's resistance increases proportionally to its bend angle. This change is measured using a voltage divider circuit.

C. Output Modules The 0.96-inch SSD1306 OLED displays the system status (Start/Stop), live letters, cleared letters, and the final word . The speaker module converts the recognized hand gestures into spoken alerts or tone-based notifications using PWM signals.

IV.RESULTS AND DISCUSSION

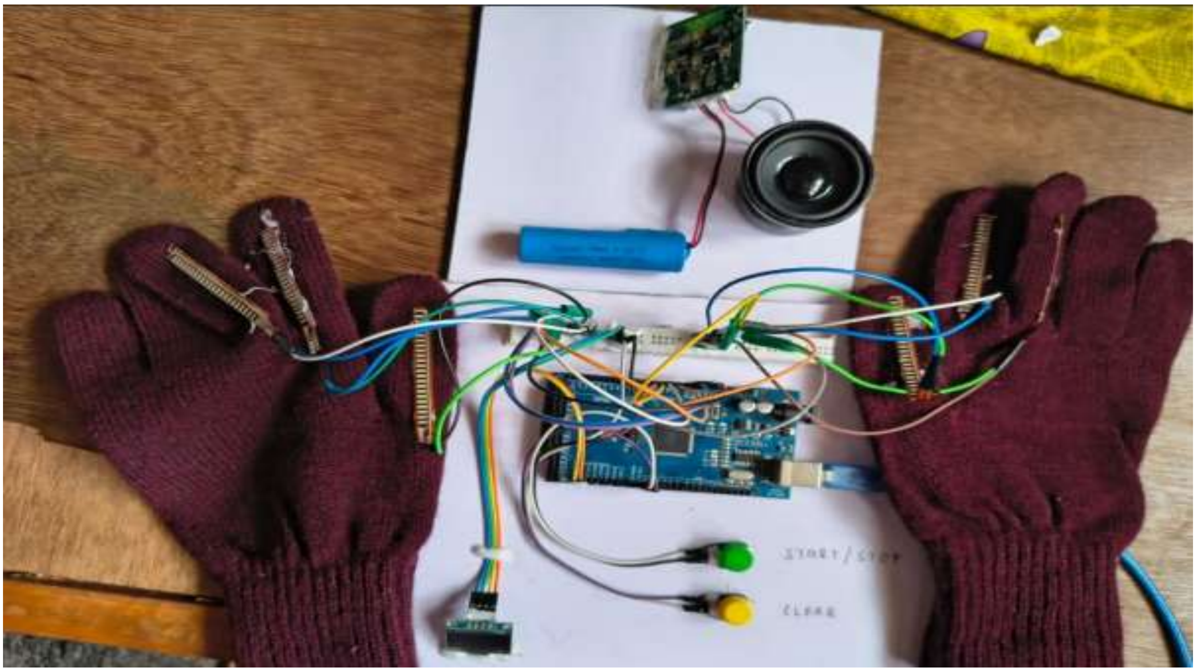
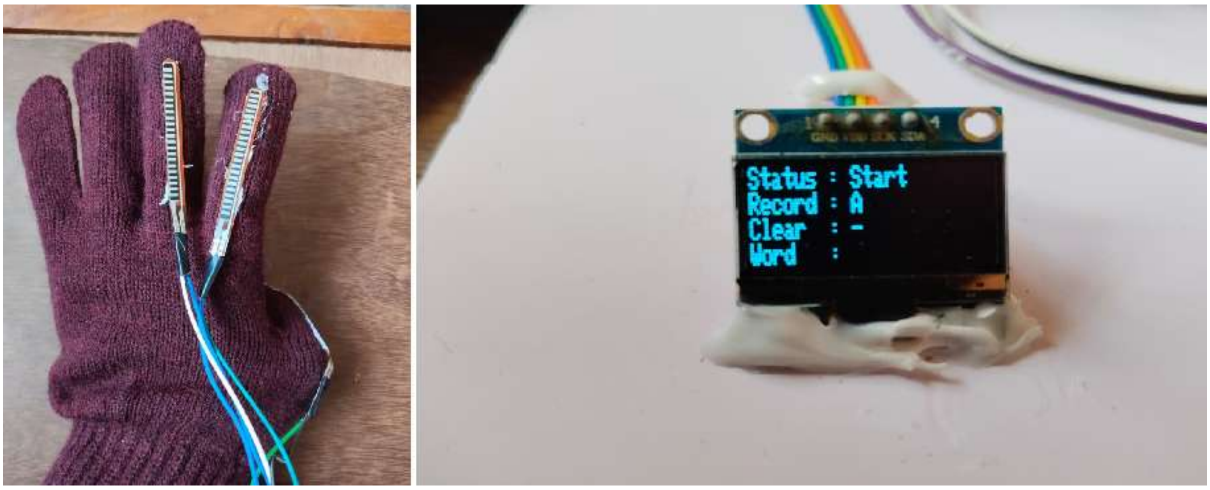


Fig. 5 Fully assembled working prototype

The proposed system successfully mapped individual finger states to specific gestures. Group 1 (S1, S2, S3) and Group 2 (S4, S5, S6) accurately determined letters A through J based on binary classifications of the flex sensor bends.



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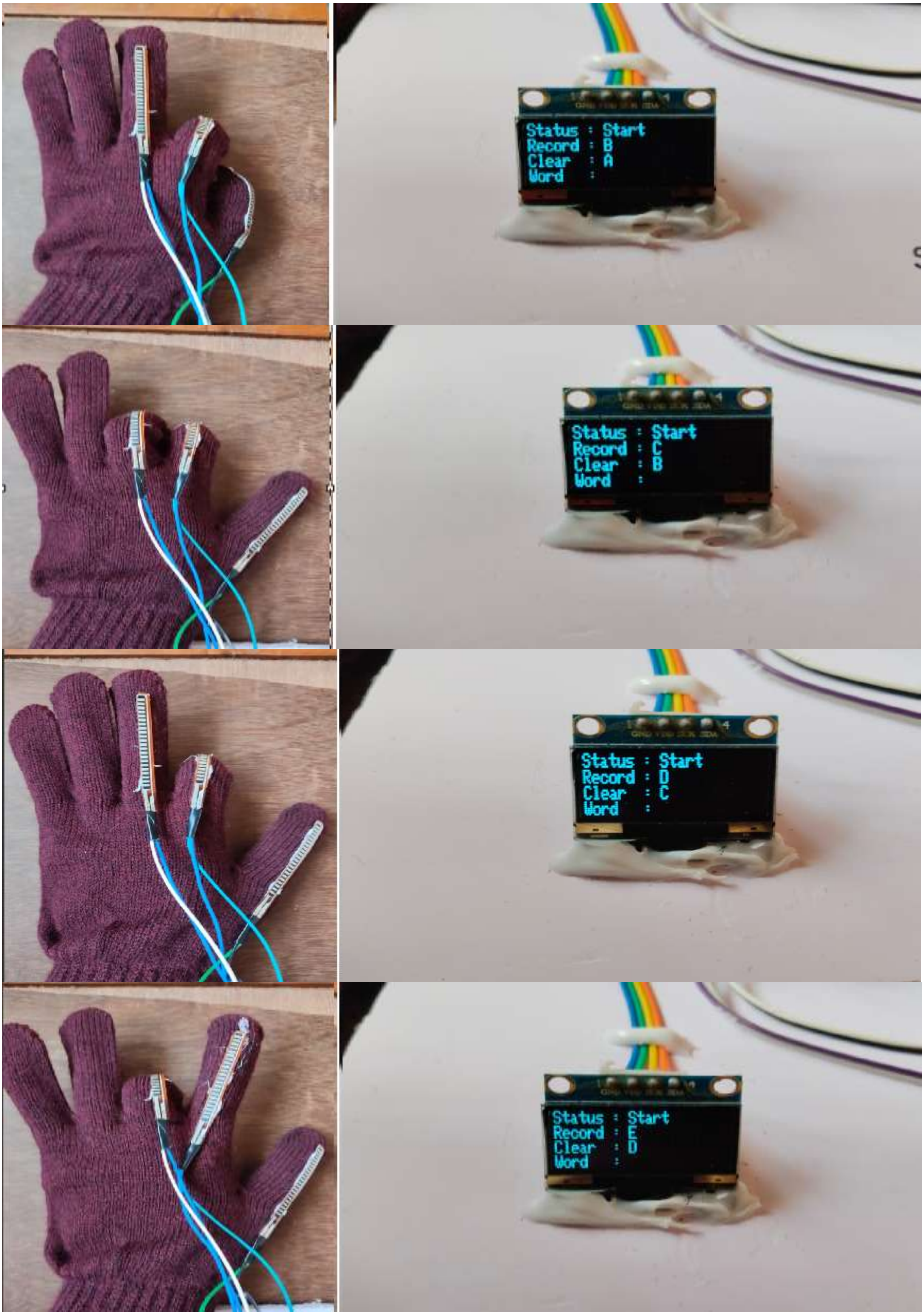

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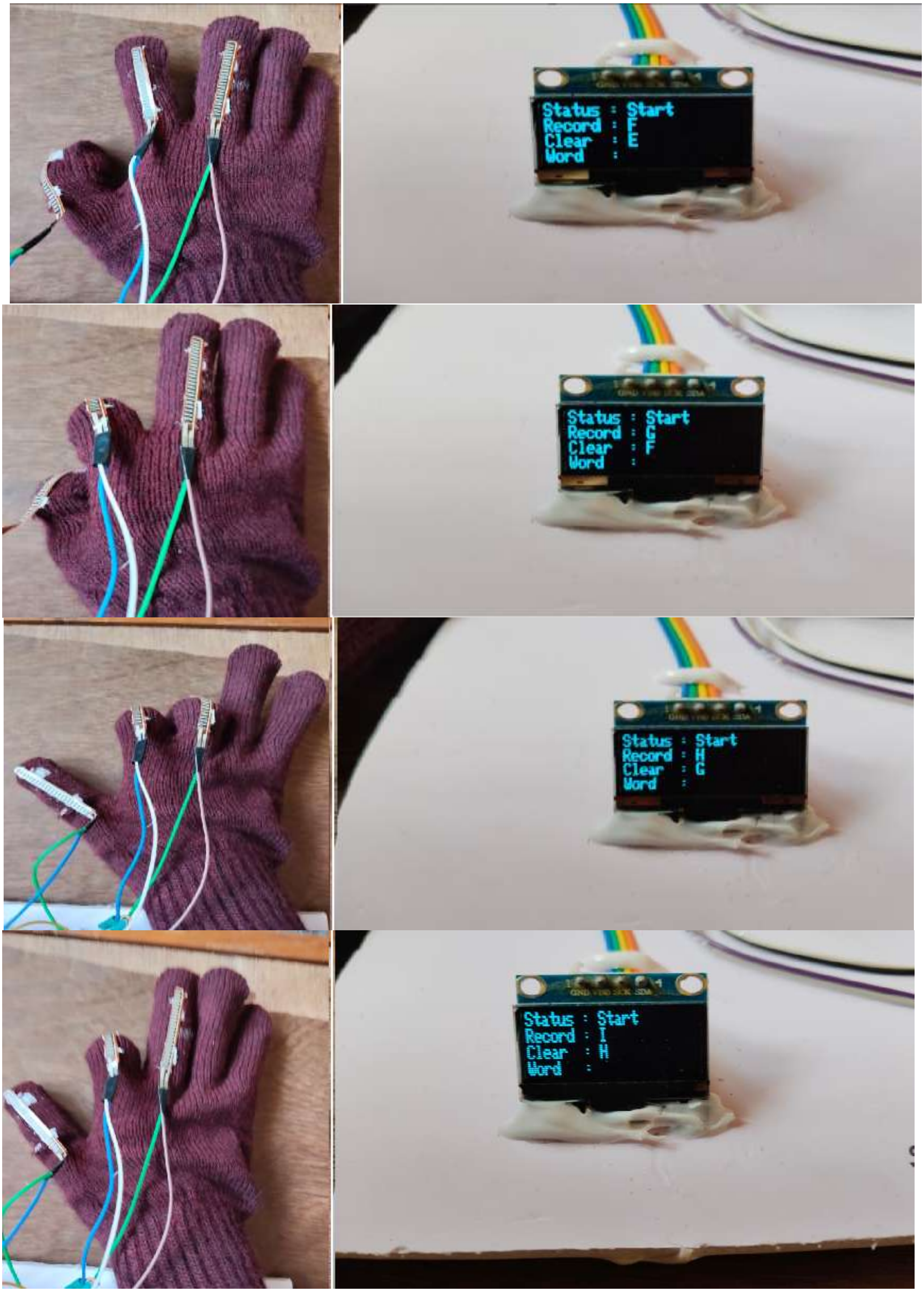

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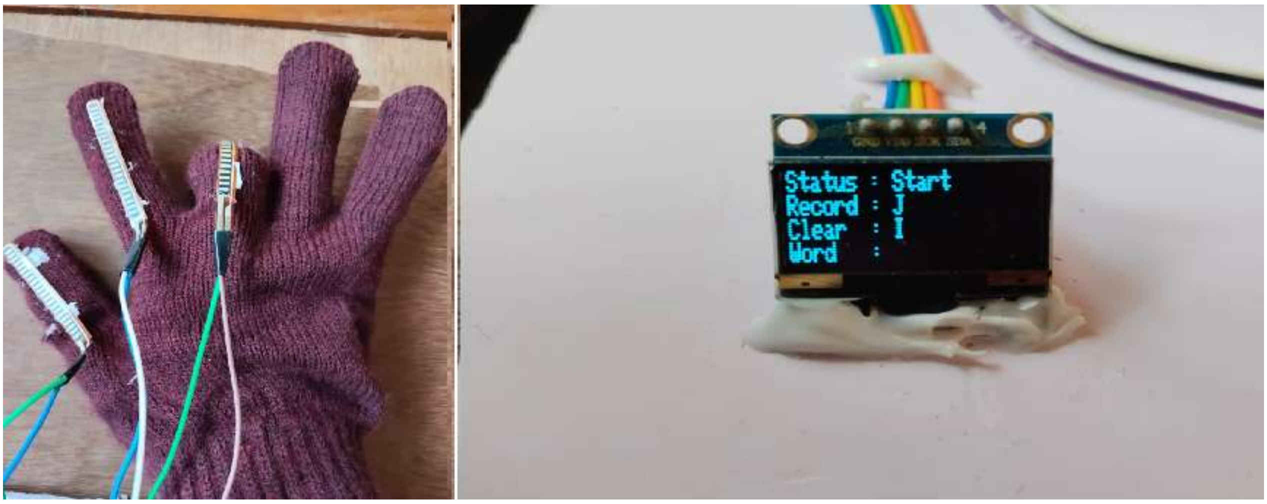
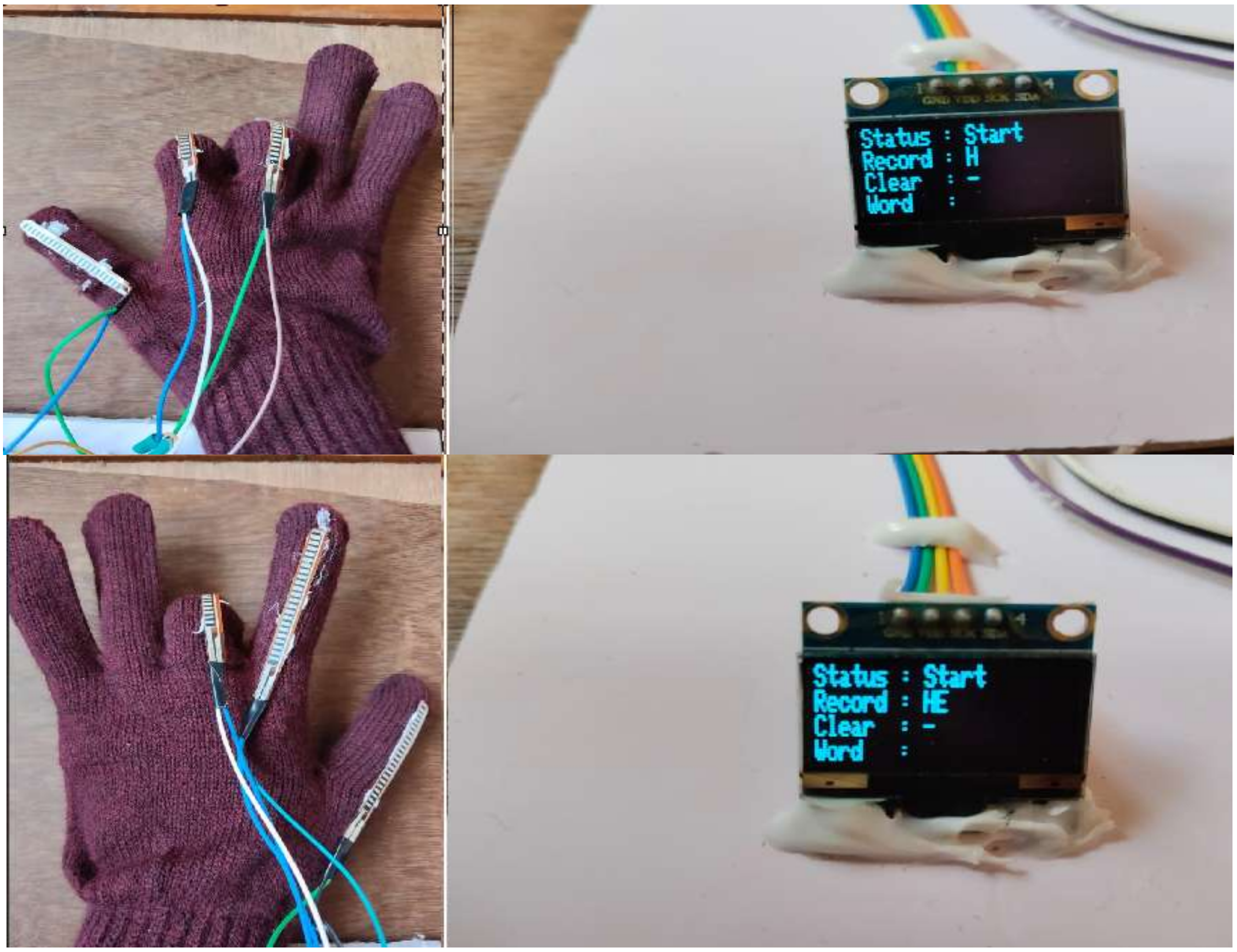


Fig. 6 Formation of letters A through J using gesture mapping

During testing, the system successfully combined individual letters to frame complete words, such as "HEAD," by detecting gesture pauses. The push buttons effectively controlled the recording sessions, and the final output was reliably displayed on the OLED and announced via the speaker. While slight variations in sensor readings were observed due to hand posture, threshold tuning ensured reliable recognition.



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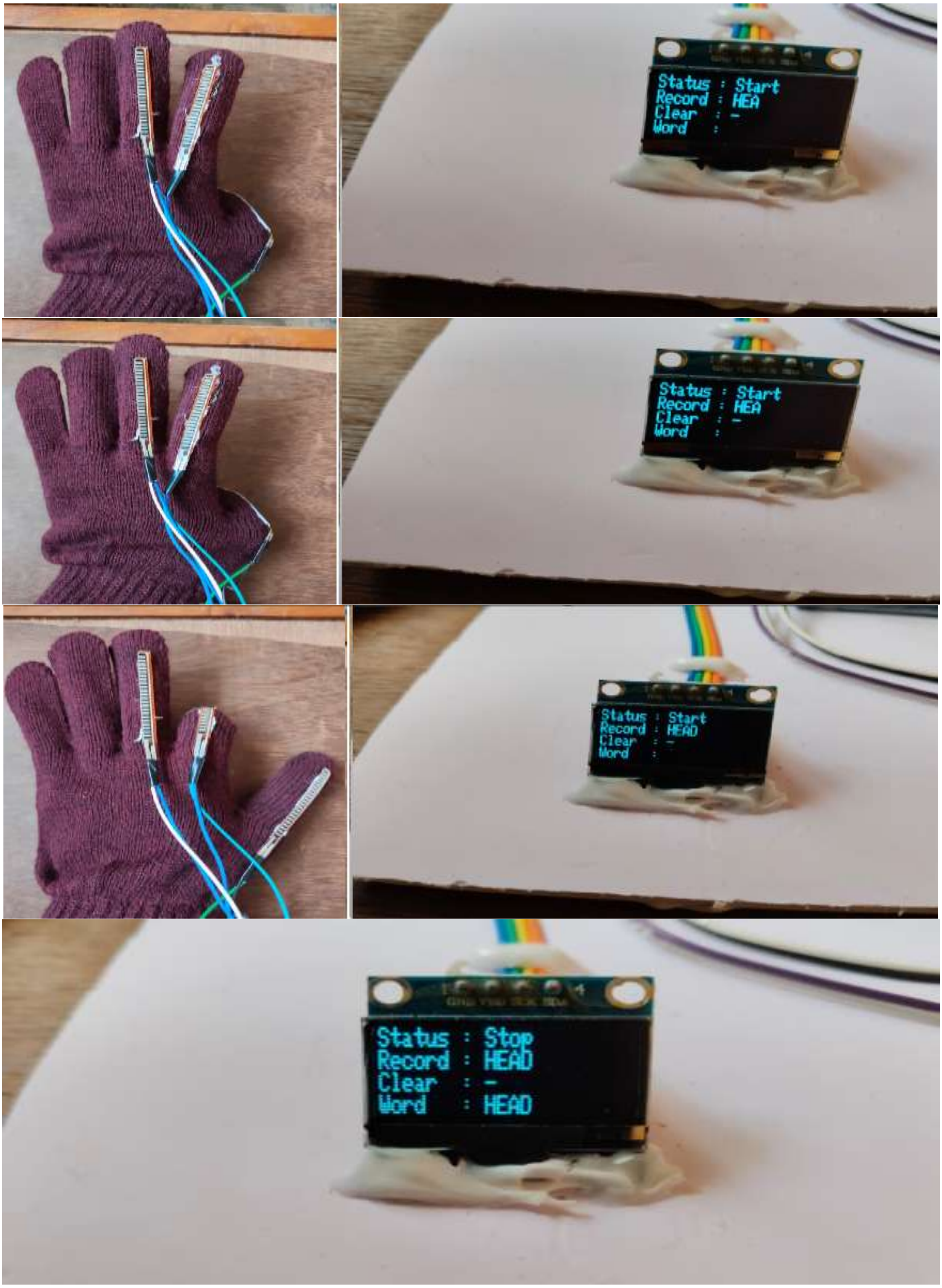

Fig. 7 Step-by-step formation of the word "HEAD"

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V.CONCLUSION

The Sign Language Translator project effectively converts hand gestures into readable text and audible speech, providing a practical communication bridge. By utilizing flex sensors and a structured decision-based algorithm, the system accurately recognizes gestures and minimizes errors through physical control buttons. This prototype demonstrates a low-cost, efficient, and scalable assistive technology with strong potential for future enhancements, such as expanding the vocabulary and integrating wireless connectivity.

REFERENCES

[1] K. Rohini, et al., "Indian and English to sign language translator - Automated portable two-way communicator," in Proc. Int. Conf. on Emerging Technologies in Engineering, 2022, pp. 1-5.
[2] S. Sripriya, et al., "Beyond Words: A Sign Language Translator," in Proc. Int. Conf. on Advances in Computing and Communication, 2021, pp. 1-6.
[3] Santhosh Kumar S., et al., "CLERC - Intelligent Sign Language Translator," International Journal of Engineering Research and Technology (IJERT), vol. 12, no. 3, pp. 210-215, 2023.
[4] U. Gautam, et al., "A Review on Sign Gloves for Dumb and Deaf People Using ESP32," International Journal of Scientific Research in Engineering and Technology (IJSRET), vol. 13, no. 2, pp. 45-50, 2024.
[5] M. S. Amin, S. T. H. Rizvi, and M. M. Hossain, "A Comparative Review on Applications of Different Sensors for Sign Language Recognition," vol. 8, no. 4, article 98, 2022.
[6] B. Pathrikar et al., "Word Level Sign Language Translation using Deep Learning," Journal of Engineering Science and Technology Review, vol. 16, no. 4, pp. 180-187, 2023.