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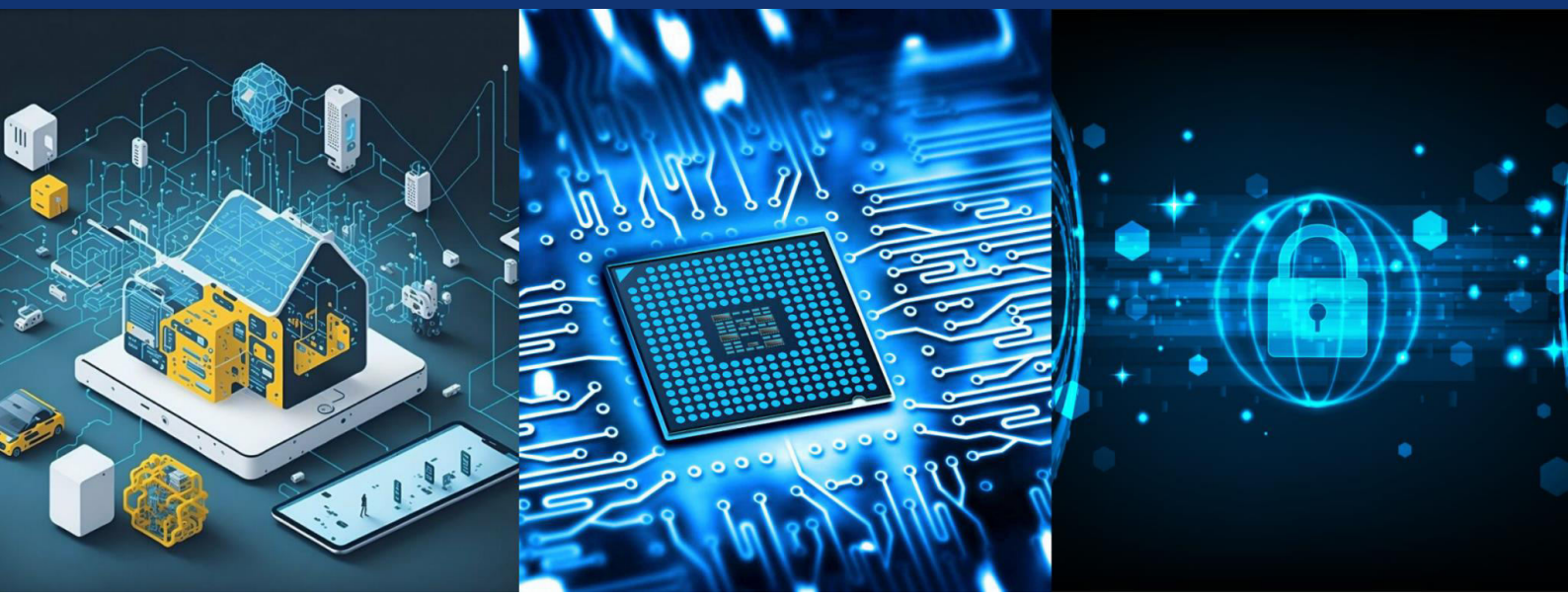

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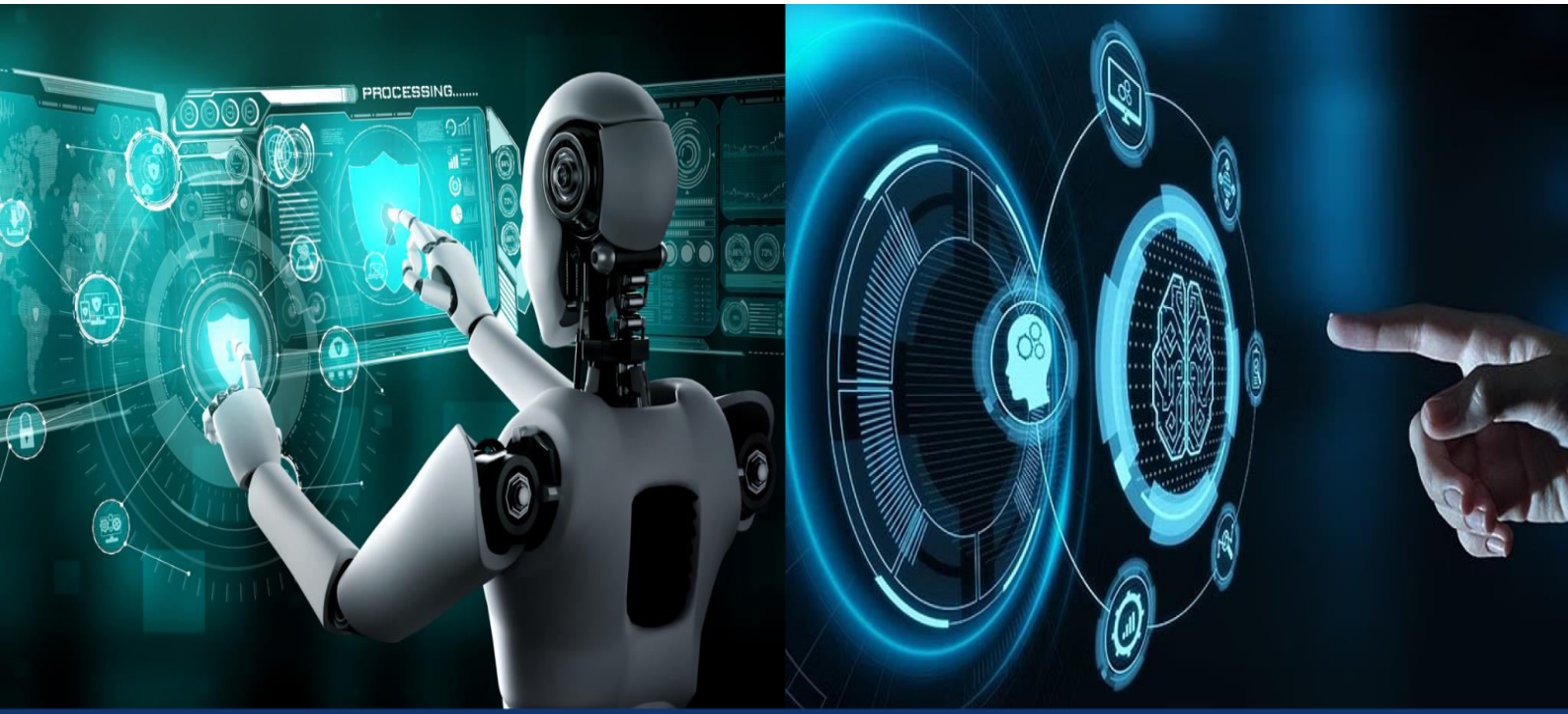

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Implementation of Multilingual Keyboard using Raspberry Pi

Dr. Aravinda.H.L, A.Vinaykumar, S.V.Naveen Kumar, Udaya Raje Urs S.P, Vishwanath. S. Navalagund

Assistant Professor, Dept. of ETE, Dr. Ambedkar Institute of Technology, Bengaluru, Karnataka, India

UG Student, Dept. of ETE, Dr. Ambedkar Institute of Technology, Bengaluru, Karnataka, India

UG Student, Dept. of ETE, Dr. Ambedkar Institute of Technology, Bengaluru, Karnataka, India

UG Student, Dept. of ETE, Dr. Ambedkar Institute of Technology, Bengaluru, Karnataka, India

UG Student, Dept. of ETE, Dr. Ambedkar Institute of Technology, Bengaluru, Karnataka, India

ABSTRACT: The objective of this project is to create a plug and play user-friendly USB device that can support typing in many different languages without the hassle of installing any additional software on the computer. It is built using a Raspberry Pi Pico, which has an RP2040 microcontroller and 40 programmable GPIO pins. It can type in different languages and switch between them instantly. It lies between the keyboard and the computer, modifying keypresses to type in different languages. It doesn't require any additional power and works like a regular USB keyboard.

KEYWORDS: Unicode, scancode, raspberry pi pico, character mapping, USB, pico SDK, microcontroller, compilers.

I. INTRODUCTION

In our increasingly interconnected world, the need for multilingual communication tools continues to grow. Traditional keyboards, optimized for Latin script, often fall short in accommodating the diverse writing systems used globally. This paper proposes a novel keyboard attachment designed to seamlessly integrate with existing devices, enhancing their capability to input and process a wide array of scripts. The attachment utilizes a modular design approach, featuring interchangeable keycaps that can be customized to display various characters from different scripts. Each keycap module incorporates smart technology capable of detecting user preferences and dynamically adjusting its input method accordingly. This adaptability is complemented by a robust software component that supports real-time script switching, ensuring fluid transitions between languages without interrupting the user's workflow. Furthermore, ergonomic considerations have been prioritized in the attachment's design, aiming to provide comfort and efficiency across diverse typing styles. User testing and feedback loops have informed iterative improvements, resulting in a product that not only meets but exceeds usability expectations across global markets. In conclusion, this keyboard attachment represents a significant advancement in facilitating cross-cultural communication through technology. By bridging the gap between linguistic diversity and digital interaction.

II. METHODOLOGY

Overview: This methodology outlines a high-level approach to enabling text input in Indian/Asian languages directly within the Windows operating system without the need for any additional hardware or software components.

Leveraging Unicode: The system will primarily utilize the Unicode standard, which assigns unique codes to every character and script worldwide. Unicode Character Mapping: Define Character Mappings: Create comprehensive mapping tables that associate specific key combinations on the standard QWERTY keyboard with their corresponding Unicode code points for each desired Indian/Asian character.

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Consider Context : Implement context-sensitive mappings to handle homophones and other nuances of Indian/Asian languages. For instance, the mapping for a specific key combination might change depending on the preceding characters.

INPUT HANDLING

Keystroke Capture : The system will intercept keystrokes directly within the Windows operating system. This can be achieved through system-level hooks or low-level keyboard input APIs. Keystroke Analysis: Analyse the sequence of keystrokes to identify the intended Unicode character based on the defined mapping tables. Unicode Character Generation: Generate the corresponding Unicode character based on the analysed keystroke sequence. Character **Rendering :**Unicode Support in Windows: Windows operating system inherently supports Unicode. The generated Unicode characters will be directly rendered by the system's text rendering engine. Application Compatibility: Ensure seamless integration with various applications that support Unicode input. Real-Time Processing and Output Objective: To use it as a device which supports typing in multiple languages. Process: The device directly takes input from user and displays the respective mapped symbol. For every key pressed by user there will be an Unicode mapped, And that will be displayed accordingly.

III. PROPOSED SYSTEM

The proposed system involves a hardware device that connects a USB keyboard to a computer, functioning as an intermediary between the two. The device captures keypresses from the keyboard and translates them into the corresponding characters of a selected Indian script. This enables users to type in Indian languages as if they were using a native keyboard layout designed for the specific script, eliminating the need for physical keyboard layout changes.

The system is designed to be programmable, supporting multiple Indian scripts to cater to a diverse range of languages. Users will be able to switch between scripts such as Hindi, Tamil, Bengali, and others, depending on their language preferences, providing flexibility for various typing requirements. Additionally, the system will offer customizable keyboard layouts, allowing users to tailor their typing experience to the conventions of specific Indian languages. This adaptability will optimize input efficiency and enhance the overall usability of the device for different linguistic contexts.

IV. WORKING

Receiving Keyboard reports from keyboard:

When a key is pressed in a keyboard, keyboard sends a 8-byte report that contains information of pressed keys.
The report contains scan codes to identify pressed keys,
“0x10” is sent when ‘Q’ is pressed
“0x11” is sent when ‘W’ is pressed
“0x01” is sent when ‘ESC’ is pressed
“0x1C” is sent when ‘ENTER’ is pressed

Mapping keys to characters and their Unicodes :

The language and the desired layout is selected through GPIO pins, according to this information keys are mapped to their characters and Unicodes.
For standard layout for Kannada,
Q+Y maps to ‘ಕ’ by sending Unicode ‘3221’.
Q+U maps to ‘ಐ’ by sending Unicode ‘3222’.
A maps to ‘ಯ’ by sending Unicode ‘3247’.
S maps to ‘ರ’ by sending Unicode ‘3248’.

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Preparing a Keyboard Report:

Since computers doesn't understand raw character data we need to prepare a "Keyboard Report" that contains how to produce that character in computer. From previous processes we have obtained necessary data corresponding to which character to produce, "ALT + Unicode in NUMPAD" produces character in computer Scan code of ALT is set to modifier byte of report Unicode is sent by reporting NUMPAD keypresses in last six bytes of report.

Sending Keyboard Report to the computer through USB:

Raspberry Pi Pico is connected to computer as USB keyboard, this Keyboard Report is sent to computer through USB with delay of 16 ms after each keypress, because computer polls keyboard every 16 ms anything changed in time less than that is not reported to computer.

Delay of 16 ms for successive keyboard reports Sending only one NUMPAD press in a Keyboard Report.

Four reports to send all four Unicode digits.

Step by Step working of the device after the key is pressed:

Step 1: When a key is pressed in keyboard then a Keyboard Report is received in RPI pico.

Step 2: Parse the Keyboard report and make a list of all keypresses received.

Step 3: Check if a any character is mapped to to be produced by this key combination, IF YES goto 'Step 5'.

Step 4: Send the received report AS IT IS if any character is not mapped to the pressed key combination and go to 'Step 9' or terminate.

Step 5: Extract the Unicode of character that is to be produced for the current key combination.

Step 6: Prepare a series of reports that indicate pressing that Unicode through NUMPAD one by one.

Step 7: Send those reports to the computer one by in order.

Step 8: Save the the pressed key list for its use in the next iteration.

Step 9: Repeat from 'Step 1' for next keypress.

V. RESULT AND DISCUSSION

we successfully achieved creating the customizable keyboard which supports local language scripts and verified it by typing the following script using the same.

```
//kannada
ಅಆಇಈಉಊಎಏಐಒಓಔ ಅಂ ಅಃ
ಕಖಗಘಙ
ಚಛಜಝಞ
ಟಠಡಢಣ
ತಥದಧನ
ಪಫಬಭಮ
ಯರಲವಶಷಸಹಳ
ಕ ಕಾ ಕಿ ಕೀ ಕು ಕೂ ಕೆ ಕೇ ಕೈ ಕೊ ಕೋ ಕೌ ಕಂ ಕಃ
```

Fig. 1 Output (Kannada)

```
//hindi
अआइईउऊऋऐऍओऔअंअः
कखगघङ
चछजझञ
टठडढण
तथदधन
पफबभम
यरलवशषसह
क का कि की कु कू के कै को कौ कं कः
```

Fig. 2 Output (Hindi)

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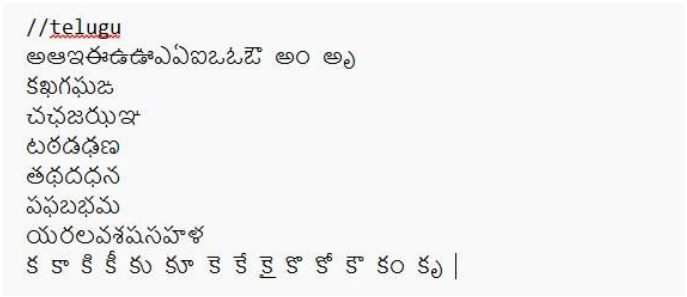

Fig .3 Output (Telugu)

Discussions:
As though it was difficult to use it for the first time, as we started using for a while we were comfortable with it.
The thing is no matter what the pattern is we can be comfortable with it once we start using it.
Also, some letters like ಕ uses 2 keys to type it ex (Q+W) gives the letter ಕ so in order to minimize the number of keys used we have used matrix format as shown below.

	Y	U	I	O	P
Q	ಕ	ಖ	ಗ	ಘ	ಙ
W	ಚ	ಛ	ಜ	ಝ	ಞ
E	ಟ	ಠ	ಡ	ಢ	ಣ
R	ತ	ಥ	ದ	ಧ	ನ
T	ಪ	ಫ	ಬ	ಭ	ಮ

Fig .4 Matrix Key Format

If in case anyone feels uncomfortable we have the feature to customize the keys according to our convenience so it will be helpful.

VI. CONCLUSION

Multilingual keyboard attachments facilitate seamless communication across languages, benefiting various sectors. In professional settings, they enhance global collaboration, streamline translation, and ensure culturally sensitive messaging. These keyboards also aid in data entry and management across diverse languages. For language learners, they provide practical tools for mastering multiple scripts, while supporting efforts to preserve endangered languages. Additionally, multilingual keyboards improve accessibility for individuals with disabilities by integrating with assistive technologies, offering alternative input methods. In creative fields, they empower artists, writers, and scholars to incorporate diverse scripts into their work, fostering cross-cultural understanding. Overall, multilingual keyboard attachments promote efficiency, inclusivity, and cultural preservation by breaking down language barriers, supporting global communication, and enriching creative expression. They play a pivotal role in facilitating global dialogue and collaboration across professional, educational, and creative domains

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