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Abstract:

Traditional methods of calculating Body Mass Index (BMI) can be time-consuming and prone to errors. To address these challenges, this report presents the design and development of an embedded system that utilizes an ultrasonic sensor and a 4x4 keypad to accurately and efficiently calculate BMI. The system is built around the PIC 16F877A microcontroller, which integrates various hardware modules and communicates with the ultrasonic sensor, keypad, and LCD display. The electrical design ensures proper connectivity between the components, while the mechanical design incorporates a 2.1-meter wooden stick with the ultrasonic sensor positioned on top to measure the user's height. The software design utilizes the C programming language, enabling real-time BMI calculations and display on the LCD screen. Challenges encountered during the project, such as system resetting and the unavailability of a suitable load cell, are addressed with improvement suggestions. Overall, this project demonstrates the successful integration of components to build an embedded system for BMI assessment, highlighting the importance of perseverance and problem-solving in embedded system development.

Introduction and Background:

Traditional BMI calculation methods can be time-consuming and prone to errors. To overcome these challenges, this report presents the design and development of an embedded system that uses an ultrasonic sensor and a 4x4 keypad to accurately and efficiently calculate BMI.

The heart of this embedded system is the PIC 16F877A microcontroller, which integrates and controls various hardware modules. The system interacts with an ultrasonic sensor, keypad, and a 16x2 LCD display to calculate BMI in real-time and display the results. By combining these components, users can easily input their weight using the keypad and instantly see their BMI on the LCD display.

The electrical design of the system involves connecting the components to the appropriate ports on the microcontroller, ensuring effective communication between the microcontroller, ultrasonic sensor, keypad, and LCD display. Additionally, a wooden stick is used as a height measurement tool in the mechanical design, providing reliable input for accurate BMI calculations.

The software design utilizes the C programming language with MIKRO C pro to develop the necessary code and algorithms. The software enables the microcontroller to collect weight data from the keypad, measure height using the ultrasonic sensor, calculate BMI in real-time, and display the results on the LCD screen. The use of C language ensures efficient execution and facilitates the integration of all system components.

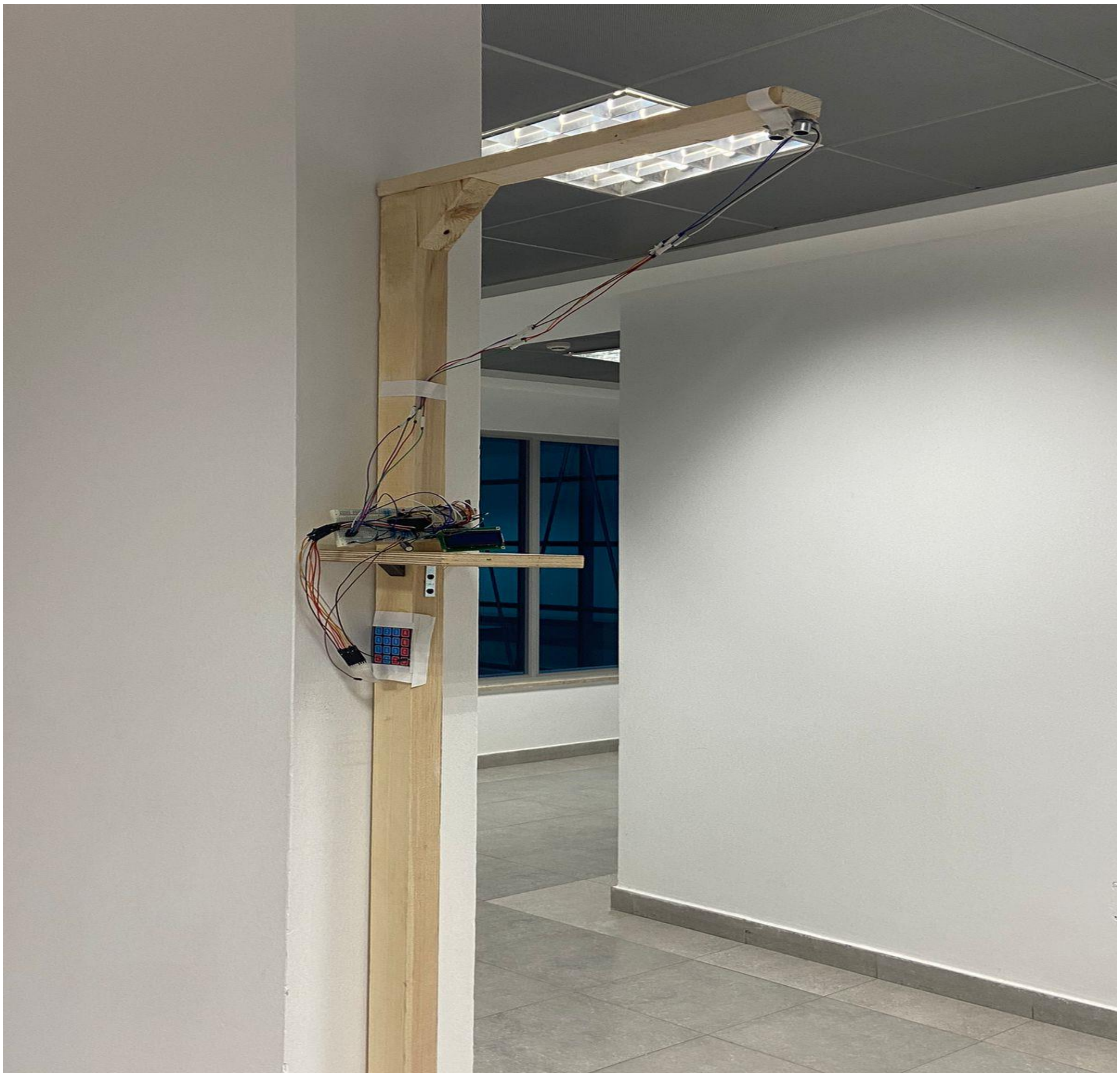
During the project, certain challenges were encountered, emphasizing the iterative nature of embedded system development. Two notable difficulties were system resetting and the unavailability of a suitable load cell for weight measurement. System resetting issues can occur due to improper hardware connections, electrical noise, or software bugs. The absence of an appropriate load cell affected accurate weight measurement, which is essential for BMI calculations. To overcome these challenges, improvement suggestions are provided, including the recommendation to replace the keypad with a load cell that can accurately measure weight.

In conclusion, this project demonstrates the successful integration of components to create an embedded system for BMI assessment. The use of an ultrasonic sensor, keypad, and PIC 16F877A microcontroller, along with the software design, allows for real-time BMI calculations and immediate display of results. Despite the encountered challenges, the project highlights the importance of perseverance and problem-solving in embedded systems. By implementing the suggested improvements, future iterations of this system can achieve even higher accuracy and usability, contributing further to health assessment and monitoring.

Design:

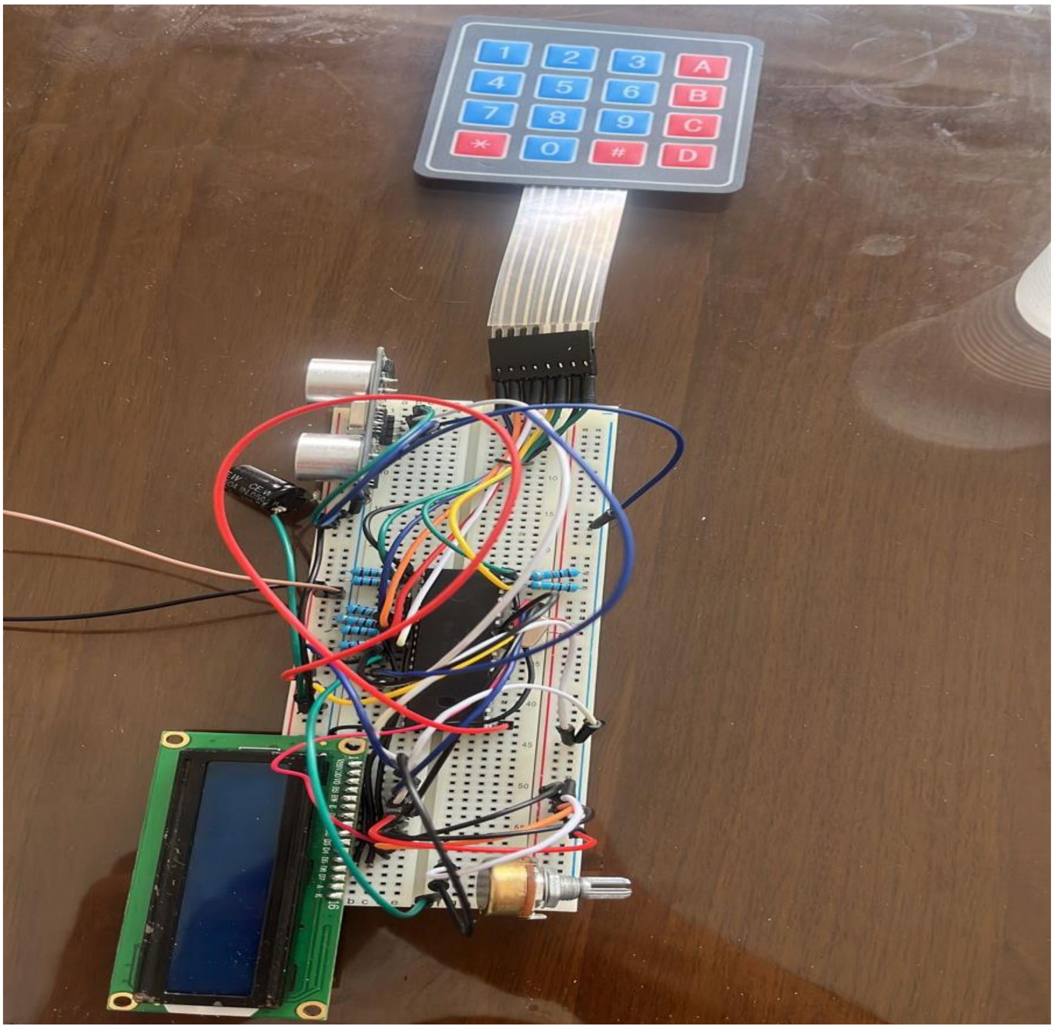
Mechanical:

In the mechanical design of our project, we use a wooden stick that is 2.1 meters long. We place the ultrasonic sensor on top of the stick to accurately measure the user's height.



Electrical:

The electrical design of our project involves using a PIC 16F877A microcontroller as the main component. We connect an ultrasonic sensor, an 8MHz oscillator, a 16x2 LCD display, and a keypad to the microcontroller. The keypad is connected to PortD on the microcontroller using 10kohm resistors, we added the resistor because the microcontroller is sensitive and we want to ensure it receives the optimal voltages (5V) and prevent it from going more than 5V. Additionally, we use a potentiometer to control the brightness of the LCD display. To ensure the microcontroller's stability, we connect a capacitor between VCC and the ground to prevent any voltage drop. This simplified electrical design ensures the effective and reliable operation of our embedded system.

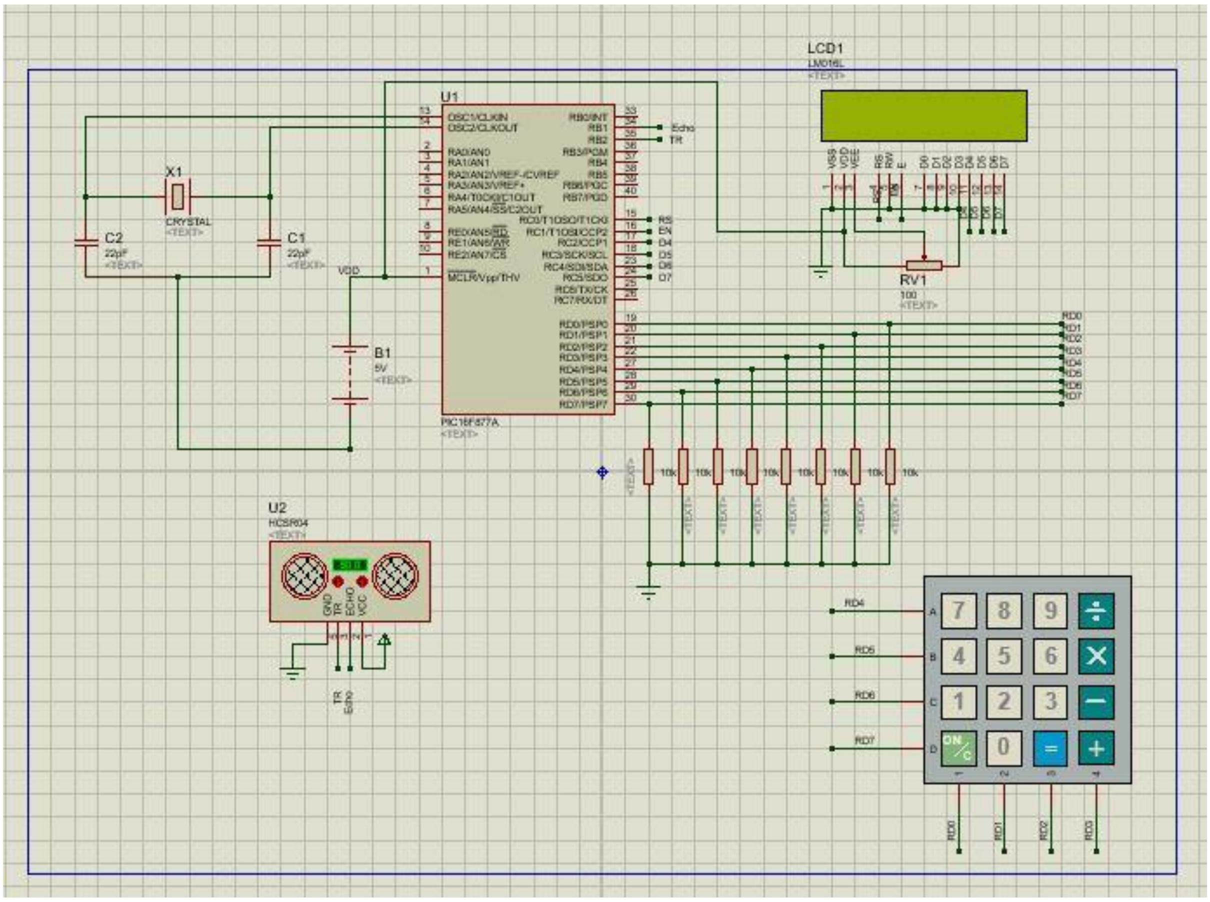


Software:

We placed the ultrasonic sensor on the tip of the stick that is 2.1 meters long which measures the height of the user by first measuring the distance between the sensor and the person standing below it, then deducting the result by 2.1. this gives an accurate measurement of the user's height.

We have a 4x4 keypad(ZRX-543) that allows the user to measure their height and then to take the user's weight as a keypad input; once the user's height and weight are provided we can then calculate their BMI and give the result as an output on the LCD

Before starting to work on the project using sensors and wires. We used proteus software to test our theory and come up with a plan and simulate the project



Problems and Recommendations:

Throughout the project, we faced various challenges. The most difficult challenge was the system resetting repeatedly, which required troubleshooting and debugging. Additionally, we were unable to find a suitable load cell within reach to measure human weight, Which posed a challenge in accurately calculating the BMI. To start overcoming these challenges, we provided recommendations, these recommendations include the replacement of the keypad with a load cell capable of measuring human weight, thus improving the accuracy and functionality of the system.

Conclusion:

In conclusion, our project showcases an embedded system designed for BMI assessment. The integration of an ultrasonic sensor, keypad, and PIC 16F877A microcontroller, supported by meticulous software and electrical designs, enables real-time BMI calculations and immediate display of results on the LCD screen. The use of a wooden stick with the ultrasonic sensor positioned on top in the mechanical design ensures accurate height measurement. Challenges encountered during the project, such as system resetting and the lack of a suitable load cell, have provided valuable insights for improvement. By implementing suggested enhancements, future iterations of this system can achieve even higher levels of accuracy and usability. This project exemplifies the significance of perseverance and problem-solving in the field of embedded systems. Prior to the hardware implementation, we utilized Proteus software for simulation and planning, allowing us to test our theories and develop a solid project plan.