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Smart BMI Machine

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Abstract: *Obesity, which refers to excess body fat in the body, has become a popular and important public health problem. Body mass index (BMI) is metric currently in use for defining obesity or anthropometric height/weight characteristics in adults and for classifying them in groups. It is unarguable that rather than error-prone manual BMI calculations, an automatic BMI computation is a preferred option. This paper presents the design and development of a low-cost automatic BMI machine for indoor and out-door use. The proposed automatic BMI machine consists of 7 main sections, namely: 1). Half bridge load-cell arranged in Wheatstone bridge configuration which incorporates internally mounted SR-120 foil-type strain gauges; 2). load-cell HX711 amplifier module; 3). HC-SR04 ultrasonic sensor module; 4).Arduino UNO development board; 5). A liquid crystal display (LCD) module; 6). DHT22 Temperature sensor; and 7). A WiFi module ESP8266. The proposed automatic BMI machine have been designed, constructed and deployed for automatic BMI measurements, and the results have been compared with manual measurements. The performance of the proposed low-cost automatic BMI machine shows that it can be used in homes, hospitals, companies as well as in any environments where routine BMI monitoring may be desired.*

Keywords: Body Mass Index; Weighing machine; Internet of Things; Obesity

I. INTRODUCTION

Due to its low cost and ease of assessing health risks associated with obesity, this method is more extensively utilised than other body fat detection techniques. In this study, a body mass index was used to estimate the overall fat content of a person's body. The BMI is calculated using two variables: the person's height and weight. BMI is a machine that was created with the use of a load cell and an ultrasonic sensor. The load cell, also known as a weighing mechanism, is used to calculate a person's body weight, and an ultrasonic height calculating mechanism is used to compute a person's height. The person's weight is measured in kilogrammes, while their height is measured in metres in accordance of the BMI standard formula.The load cell calculates the person's weight and turns the mechanical force into electrical signals that can be easily obtained after microcontroller processing. The height of a person is calculated by an ultrasound sensor with built-in transmit and receive circuitry because when the ultrasound signal is transmitted by the transmitter, it reflects back to the receiver after striking an object or person, and height is calculated by multiplying the ultrasound signal's speed and the time it takes to return to the sensor. The DHT22-Temperature sensor calculates the body temperature. The microcontroller manipulates all of the data, and the outcome is presented on the LCD display.The goal of the study was to create a BMI unit that provides a quantitative number and a percentage that corresponds to body fat composition. If the numeric value is less than 20, the person is considered underweight; if the value is between 20 and 25, the person is regarded healthy. Overweight is defined as being over 25 pounds overweight, and obesity is defined as being over 35 pounds overweight. In this scenario, a precise device, such as an immersion tank, is required to calculate % body fat. The BMI is calculated by dividing a person's weight in kilogrammes by the square of his or her height in metres. BMI is a rough estimate of body mass index.

Overweight or underweight of the body is determined by dividing the height by the weight. Of the body in kg by the square of height in meters.

That is:

$$BMI = \text{Weight (kg)} / \text{Square of Height}(m^2) \quad (1)$$

In some circumstances where the danger of death for an overweight person is high, BMI is a useful tool for health care professionals and investigators. One extra pound can place someone in a dangerous scenario. One of them is those with coronary heart disease. Fat builds up in our bodies, clogging veins and causing a variety of ailments. To overcome the margin of error, an automatic or electronic body mass calculator could be useful. According to the World Health

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Organization, approximately 3 million people die each year as a result of being overweight or obese. BMI can help you determine if your weight is in a healthy relation to your height. A BMI of 18.5 to 24.9, according to the National Institute of Health, is optimum.

Table 1: Classification of overweight and obesity in adults

Sr. No.	BMI	Weight Status
1.	Below 18.5	Underweight
2.	18.5 to 24.9	Normal
3.	25 to 29.9	Overweight
4.	Above 30	Obese

II. Literature Survey

Mr. Shrikant J. Honade's Height, Weight, and Body Mass Index Measurement with Matlab The camera is utilised to capture the image of the individual whose height is to be measured in this paper's proposed method. The webcam image acquisition toolkit is used to capture the image. Following the capture of the candidate's image, the image is processed using MATLAB's efficient digital image processing tool. Also, a weight sensor is used to determine a person's weight, and Body Mass Index (BMI) is calculated using height and weight to determine a person's fitness. The paper's flaw is that the process for weight measuring necessitates unique circuitry including a microcontroller, Op-Amp, and ADC, which is not feasible. In this method, an AVR microprocessor was used for sampling analogue signals as well as weight monitoring. Finally, failure detection at zero level was carried out utilising Probabilistic Neural Networks, increasing system safety.

Moradkhani's Load Cell Design and Construction with Fault Detection by Probabilistic Neural Network A strain gauge load cell has been built as a S model in this study, which is utilised to measure weight. Four approaches for repairing and balancing Whetstone Bridge were explored, and one method was eventually found to produce the best Whetstone Bridge outcome. For amplifying and measuring changing resistance and voltage in the Whetstone Bridge, four current amplifying and measuring methods were used, with one of them being modified to create the main model. In this method, an AVR microprocessor was used for sampling analogue signals as well as weight monitoring. Finally, employing Probabilistic Neural Networks to detect fault detection at zero level was carried out hence, safety of system was increased.

III. Design/Method/Algorithm

3.1 Block Diagram

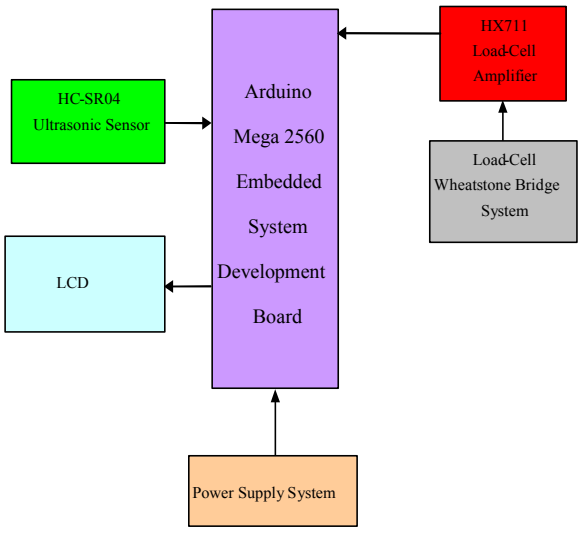

Figure 1: Block Diagram of proposed Smart BMI Machine

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The block diagram of the proposed low-cost automatic BMI machine is shown in Fig. 1. The proposed low-cost automatic BMI machine basically consists of 8 main sections, namely: 1) power supply module. The weight measurement is accomplished using the half bridge load-cell assembly via the load-cell amplifier module while the height measurement is achieved using the HC-SR04 ultrasonic sensor module. The weight and height measurement modules are interface to the Arduino UNO development board where the BMI is computed automatically via a computer program embedded in the Arduino UNO development board and half bridge load-cells arranged in Wheatstone bridge circuit configuration format which incorporates internally mounted SR-120 foil-type strain gauges for weight measurement; 2). load-cell HX711 amplifier module which will be used to amplify the millivolt (mV) from the half bridge load-cell weighing system; 3). HC-SR04 ultrasonic sensor module which is the main sensor used in this work for height measurement; 4). Arduino UNO board is the heart of the proposed BMI machine; 5). liquid crystal display (LCD) module where the height, weight and BMI measurements and body temperature will be displayed. 8).ESP8266 Wi-Fi modulefor making Cloud based website.

3.2 Flowchart

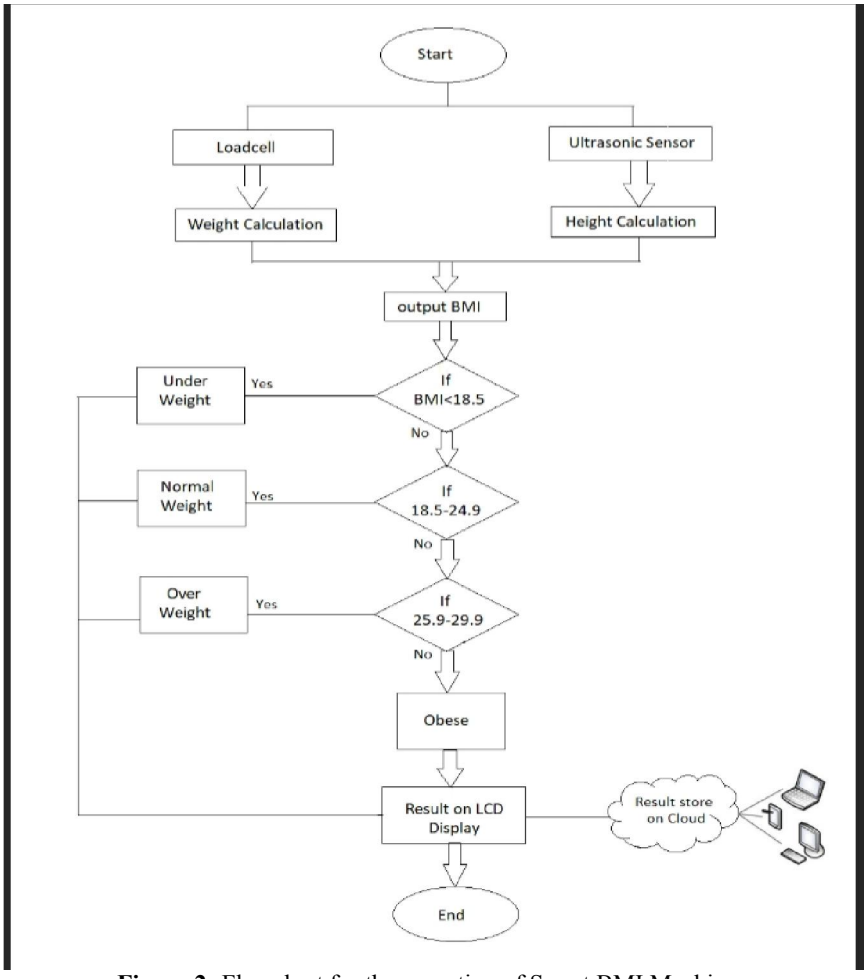

Figure 2: Flowchart for the operation of Smart BMI Machine

IV. Hardware Implementation and Operation

4.1 Sensor

A. Arduino Uno

The Arduino Uno is an open-source microcontroller designed by Arduino and based on the Microchip ATmega328P microcontroller. The board has a number of digital and analogue input/output (I/O) pins that can be used to connect to

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other expansion boards and circuits. The board contains 14 digital I/O pins and 6 analogue I/O pins, and it can be programmed using the Arduino IDE and a USB type B connector.

B. Ultrasonic Sensor

The HC-SR04 ultrasonic sensor, like bats, employs SONAR to estimate the distance of an object. From 2cm to 400cm (1" to 13 feet), it provides outstanding non-contact range detection with high precision and reliable readings in an easy-to-use design. The Ultrasonic Sensor employs sound reflection to determine the time difference between the delivered and received waves. The user's height is measured using an ultrasonic senso

C. LCD (Liquid Crystal Display)

The light modifying properties of liquid crystal paired with polarises are used in a flat panel display or other electrically modulated optical systems. The user's BMI is displayed on an LCD panel.

V. CONCLUSION

A BMI machine was devised and built in the area. The machine was put to the test, and the findings were almost identical to those of ready-made scales with very few errors. The BMI machine can be used to track changes in a person's health. It is a key measure of nutritional status, as being underweight, normal, overweight, obese, or extremely obese has a negative impact on mortality and morbidity rates.

This BMI machine cost around Rs. 2380 to build, but a standard BMI machine costs around Rs. 3999 in the market. The locally designed BMI machine has various advantages over commercially available, highly customized BMI machines. Local serviceability, affordability, and simplicity are among them..

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