Solar-Energized Continuous Health Monitoring Device

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Abstract- *With the increasing need for effective healthcare solutions for the elderly, real-time health monitoring has become essential. Existing home-based healthcare systems often face limitations such as power dependency and restricted monitoring capabilities. This paper proposes the design and implementation of an Arduino-based health monitoring system that measures key health parameters, including height, weight, body mass index (BMI), body fat percentage.To ensure uninterrupted operation, the system incorporates a solar panel for continuous power supply, making it suitable for remote and off-grid areas. The collected data can be displayed on an integrated screen or transmitted to a mobile application, enabling real-time monitoring by caregivers and healthcare professionals. By providing continuous health tracking, this system aims to improve elderly healthcare, facilitate early detection of health issues, and reduce the need for frequent hospital visits.*

Keywords- Arduino Mega(2560), BMI(BodyMass Index).

I. INTRODUCTION

Taking care of elderly people is becoming more important as their number is increasing. Many of them find it hard to visit hospitals regularly due to problems like difficulty in moving, high medical costs, or the lack of someone to help them. Because of this, a system that can check their health from home is needed. This project presents a health monitoring system using Arduino, which can measure important body details like height, weight, body mass index (BMI), body fat percentage. These details help in knowing a person’s health condition and detecting healthA special feature of this system is its solar-powered operation, which keeps it running without interruptions, even in places where electricity is not always available. The system has an LCD display that shows the health readings, and the data can also be sent to a mobile application so that doctors and caregivers can check the health status from anywhere. This helps in quick medical attention and reduces emergencies.

The system works with different sensors and load cells to measure health signs accurately. It uses Arduino Mega 2560 and Arduino Nano for handling and sending data between different parts. Important component like HX711 load cell amplifier help in getting correct readings.

According to the World Health Organization (WHO), millions of deaths occur annually due to these conditions, emphasizing the need for improved health monitoring solutions. Important health parameters, including Height, Weight, Body Mass Index, and body fat percentage provide crucial insights into an individual's overall health. Irregularities in these factors are linked to serious conditions such as hypertension, heart disease, and stroke, highlighting the importance of accessible and accurate health monitoring tools.

By addressing the dual challenges of energy dependency and healthcare accessibility, the device represents a transformative step toward improving global health outcomes while promoting environmental sustainability. This introduction sets the stage for exploring the design, implementation, and potential impact of the device in revolutionizing healthcare delivery. This project focuses on developing an automated health monitoring system powered by solar energy, designed to measure key health parameters such as Height, Weight, Body Mass Index, and body fat percentage. By integrating renewable energy with innovative healthcare technology, this system provides a cost-effective, reliable, and sustainable approach to improving healthcare access and outcomes worldwide

II. EXISTING AND PROPOSED SYSTEM

The earlier system for checking health could only measure body temperature and heart rate. While these details are important, they do not give a full picture of a person’s health. If someone had other health problems, this system would not be able to detect them early. Another issue with the earlier system was that it depended only on direct electricity. If there was a power cut, the system would stop working, making it unreliable in many situations The improved system adds more features to check a person’s overall health in a better way. It can now measure weight, height, body mass index (BMI), and body fat percentage.Load cells measure weight, while an ultrasonic sensor is used to find height, and together they calculate BMI. The system also estimates body fat percentage, which is useful for understanding a person's fitness. To make sure the system works all the time, a solar panel with a battery is used as a power source.

A. *Solar panel*

A 12V solar panel is used to change sunlight into power, which helps run different devices. It has many small units that take in sunlight and turn it into electricity. This type of panel is useful for charging batteries and giving power to systems that need 12V to work. It is often used in homes, outdoor setups, and small machines that need steady power without depending on direct electricity. When connected with a battery, it stores energy so that devices can work even when there is no sunlight.

B. Ultrasonic sensor

An ultrasonic sensor is a device that measures distance using sound waves. It sends out high-frequency sound signals that bounce back after hitting an object. The sensor then calculates how far the object is based on the time taken for the sound to return. This sensor is commonly used for measuring height, detecting objects, and helping machines move without hitting obstacles. It works well in places where light or cameras may not give accurate results.

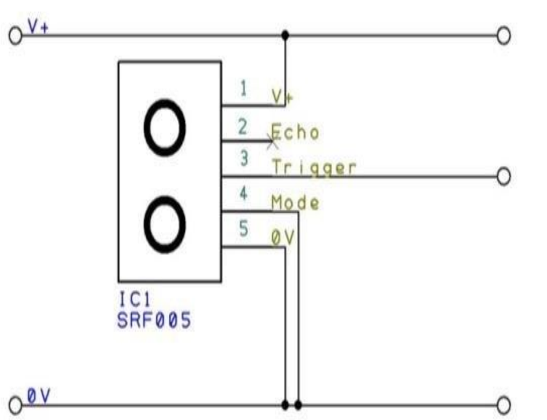

Fig.1.Schematic Diagramof Ultrasonic sensor

C. HX711 Load Cell

This setup is used for measuring weight. It includes four small metal sensors placed at the corners, which feel the pressure when something is placed on them. These sensors send signals to a small circuit board in the middle, which processes the information and converts it into weight readings. The wires connected to the board help in sending data to a display or a computer This type of system is commonly found in digital weighing machines to give accurate weight measurements. gates is often to achieve a balance between speed, power consumption and area in digital circuitdesign. The design shown in below figure

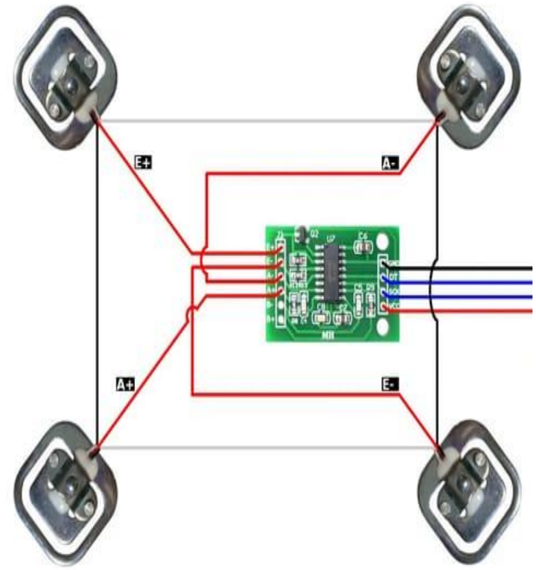

Fig.2. Diagramof HX711 Load Cell

D. *Body Mass Index(BMI)*

Body Mass Index (BMI) helps to understand if a person's weight is suitable for their height. It is calculated using the formula:

$$BMI=Weight\ (kg)/Height^2(m)$$

If the result is low, it may indicate being underweight, while a high value suggests overweight. A normal range means a healthy balance. This method is useful for checking fitness and possible health concerns.

E. Body Fat Percentage

For body fat percentage estimation, empirical formulas utilizing BMI, age, and gender-based coefficients are applied. One commonly used equation for body fat percentage estimation is:

$$Body\ Fat\%=(1.20\times BMI)+(0.23\times Age)-(10.8\times Gender)-5.4$$

where Gender = 1 for males and 0 for females. The system integrates this calculation into the microcontroller's processing unit, displaying real-time results on the LCD screen. The combination of ultrasonic height measurement, precise weight detection, and computational algorithms enables accurate and automated body composition analysis, making the system an efficient tool for health monitoring

III.SCHEMATIC DIAGRAM ANDRESULTS

A.Schematic Digram

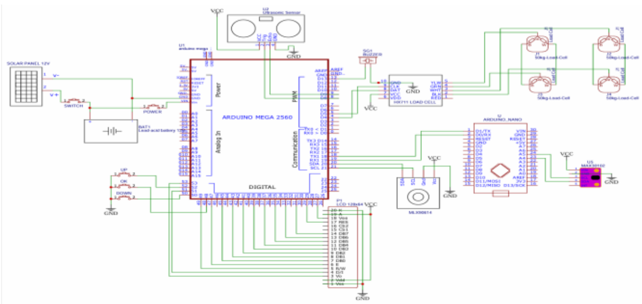

Fig.3.Schematicof health monitoring system

The setup consists of a main board that processes information from different parts, including a heart rate and oxygen sensor, a temperature sensor, and weight sensors. A power system using a solar panel and a rechargeable battery ensures it keeps running without interruption. The height measurement is done using a sensor that calculates distance. The collected data is displayed on a screen, allowing users to see their health readings in real-time. The system also includes buttons to navigate and confirm choices. All components work together to provide health tracking in a simple and automated way.

B. Results

Fig.4.Outputsof Health Monitoring System

The setup in the first capture demonstrates an embedded framework designed for real-time evaluation of physiological metrics. The system integrates sensing modules interfaced with a microcontroller unit, responsible for data acquisition and processing.The second capture focuses on a closer view of the device, where a screen displays values related to weight, height, and other physical details. A fingertip is pressed against a sensor, possibly collecting data for analysis. The setup appears to be an automated system for checking health indicators as show in figure.

Fig.5.Outputs Health Monitoring System

The image focuses on a bright screen with numbers that tell about the body's inner state. The top number shows how much air is in the blood. The middle number shows how fast the heart moves. The last number shows the skin's warmth.A hand is pressing a small part next to the screen. This touch is likely making the system collect the body's details. Below the screen, there are small round parts, which is used to change settings.

Fig.6.Outputs of health monitoring system

The setup captures key body readings using a stand-alone structure. A person stands under the frame while sensors collect details. The system takes values like height, weight, air level in blood, heart movement speed, and body warmth. A small screen shows these numbers in real time.A touch-based part allows the system to collect extra details when pressed. The buttons below the screen might help with adjusting or resetting the readings. The setup works without large tools, making it easy for quick body checks.

IV. VISUALIZATION, AND ANALYTICS

C. Body fat percentage

A. Height &Weight

The image shows a bar chart with body mass readings for four individuals. Two types of values are displayed: a standard value and a measured value. The standard value remains the same for all, while the measured value changes for each person.as shown in figure.

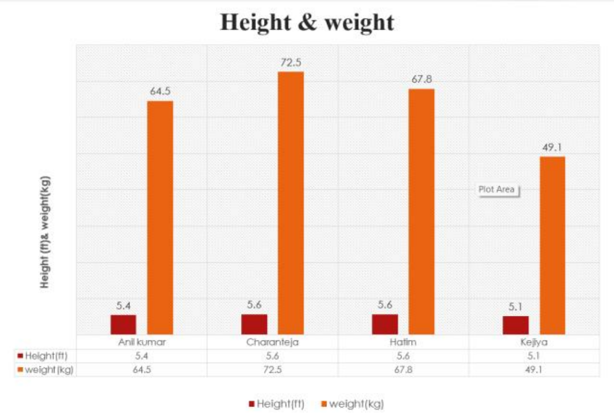

Fig.7.Comparison of height and weight

The figure represents a bar chart displaying body fat values for four individuals. Two sets of values are shown a common value and a measured value. The common value stays fixed for all, while the measured value varies for each person.

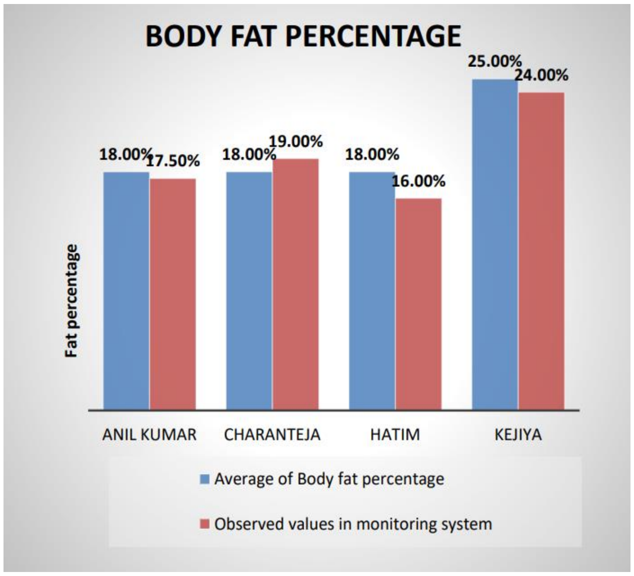

Fig.9.Comparison of Body Fat percentage

The graph titled "Body Fat Percentage" presents a comparative view of the average body fat percentage versus the observed values recorded using a monitoring system for four individuals: Anil Kumar, Charan Teja, Hatim, and Kejiya.This chart helps assess how closely individuals align with the standard fat percentage values. Minor deviations are normal, but consistently high or low values may call for lifestyle evaluation or further health analysis. The graph effectively supports monitoring health and fitness trends over time.

B. Body Mass Index

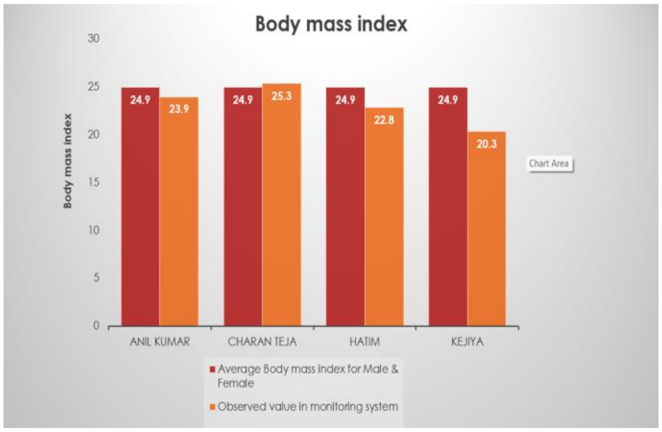

Fig.8.Comparison of Body Mass Index

This graph helps visualize how individual BMI values compare to the recommended average. It is useful for identifying who may need lifestyle adjustments, such as dietary changes or increased physical activity. Monitoring BMI trends like this supports better health assessments and preventive care.The graph titled "Body Mass Index" presents a comparison between the average BMI value (assumed to be 24.9 for both males and females) and the observed BMI values measured through a monitoring system for four individuals: Anil Kumar, Charan Teja, Hatim, and Kejiya.

TABLEI.Comparison of Height & Weight

Name	Height (ft)	Weight (kg)
Anil	5.4	64.5
Hatim	5.6	72.5
Charan	5.6	67.8
Kejiya	5.1	49.1

TABLEII.Comparison of Body Mass Index

Category	Anil Kumar	Charan Teja	Hatim	Kejiya	BMI Range
Average	24.9	24.9	24.9	24.9	Normal Weight (18.5 - 24.9)
Calculated Value	23.9	25.3	22.8	20.3	Normal (18.5 - 24.9) / Overweight (≥ 25)

TABLEIII. Comparison of Body Fat Percentage

Category	Anil Kumar	Charan Teja	Hatim	Kejiya	Body Fat Range
Average	18.00%	18.00%	18.00%	25.00%	Normal (14-24% for men, 21-31% for women)
Calculated Value	17.50%	19.00%	16.00%	24.00%	Normal (14-24% for men, 21-31% for women)

V. CONCLUSION AND FUTURES COPE

The developed system effectively integrates multiple sensors and microcontrollers to enable real-time data collection and processing for various applications. By combining an ultrasonic sensor, load cells, a temperature sensor, and a pulse oximeter with Arduino Mega 2560 and Arduino Nano, the system ensures accurate measurements and efficient communication. This setup enhances monitoring capabilities in areas such as health tracking, load measurement, and environmental sensing. Future improvements can focus on adding wireless connectivity for remote access, incorporating intelligent data analysis for predictive insights, optimizing power consumption for longer operation, and expanding sensor compatibility to increase its scope in industrial automation, healthcare, and smart systems.

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