Department of Electronic & Telecommunication Engineering
University of Moratuwa

BM 1190 - Engineering Design Project

Project Report
Team Leptons
Anthropometric Measuring Device

Submitted by:

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Abstract

The ultrasonic height measuring device is a portable and independent device designed to measure patients' heights accurately in clinics. The device aims to address the labour expense and cumbersome nature of conventional height measurement techniques. Implementation of an ultrasonic sensor, programming of a microcontroller, implementation of a circuit with a designed PCB, and enclosure design comprised the four major phases of project development. The device measures the height of patients using ultrasonic waves and displays the results on an LCD screen. The enclosure was created with portability in mind and was optimised to safeguard the device's sensitive components during transport. Technically, the project is feasible, and performance goals have been met. The device is anticipated to be utilised in clinics and medical facilities, where it may reduce labour costs and enhance the patient experience.

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1 Introduction

Measuring human height accurately is important in many fields, including healthcare, sports, and research. Moreover, height measurement is an important metric for paediatricians and their patients because height changes so rapidly during childhood and can indicate health concerns if it deviates from growth curves. The goal of this project was to create a digital version of the traditional physical height-measurement devices (also known as stadiometers) currently in use in hospitals and clinics. This device would be more portable while still maintaining the accuracy and speed of current devices.

1.1 Problem Description

Traditional methods of measuring height, such as using a measuring tape or stadiometer, require the assistance of a second person, which can be time-consuming and inconvenient. These methods have limitations that can lead to inaccurate measurements and inconvenience for both the person being measured and the person performing the measurement. Additionally, some individuals may experience discomfort or self-consciousness when being measured by another individual, which can lead to inaccurate measurements. Furthermore, clinics require a dependable and precise method for measuring patient height. This is essential for a number of reasons, including monitoring the growth of children, tracking changes in adult height, and calculating the body mass index (BMI). Traditional height measurement methods, such as stadiometers, are typically immobile and require additional personnel to assist with the measurement process. Not only does this increase the labour costs associated with height measurement, but it also makes the process more cumbersome for both the clinic staff and the patients. There is a need for a portable and independent height-measuring device that can provide accurate and reliable height measurements in clinical settings in order to address these issues. This device would reduce the labour costs associated with height measurement, eliminate the need for additional personnel to assist with the measurement process, and allow patients to

independently measure their height, thereby reducing the burden on clinic staff.

1.2 Validation of the problem

As part of our investigation into the difficulties healthcare providers face when measuring the height of their patients, we contacted healthcare professionals to gain insight into the issues they faced. The difficulty in accurately and independently measuring height, especially for patients with mobility issues or disabilities, was a problem that was frequently cited by these professionals. In addition, traditional height measurement methods, such as stadiometers, frequently require additional personnel to assist in the measurement process, which increases labor costs and makes the process cumbersome for both staff and patients.

We believe that our device will be particularly useful for clinics and hospitals that serve patients with mobility issues or disabilities, based on the feedback of healthcare professionals. In addition to reducing labor costs associated with height measurement, the device will free up personnel to focus on other crucial tasks. Our ultrasonic height-measuring device has the potential to significantly enhance the precision, efficiency, and cost-effectiveness of height measurement in healthcare settings.

1.3 The device

Our electronic height-measuring device is a portable and user-friendly device that allows patients to measure their height accurately and independently. The device is simple to use and requires minimal training or assistance. The device precisely measures the distance between the patient's head and the floor, which is then converted into an accurate height measurement. Our electronic height measurement device eliminates the

need for additional personnel, enabling healthcare providers to allocate their resources more effectively.

Its small size and portability make it suitable for use in a variety of healthcare settings, including clinics, hospitals, and nursing homes. The device is also adaptable and can be used for a variety of purposes, such as routine height measurements and monitoring children's growth.

2 Technical Feasibility

The device's primary purpose is to measure heights using a height sensor, display the data, and store it so that a doctor can enter it into a database of medical information. Consequently, this device's essential parts include a

- A distance sensor measures the distance between two objects, in this case, the patient's head's top and the ground.

- An accelerometer ensures an accurate height measurement by detecting when the instrument is parallel to the ground.

- A button to initiate measurements

- A LCD screen: presenting the data to the nurses, such as printing the findings of the height data on a screen for them to read

Component	Price	Availability
A distance sensor	Rs.1750	GY-530 VL53L0X Laser Ranging Sensor Module | Duino.lk
A LCD screen	Rs. 695	LCD-16x02-Display-Interactive-Interface-single-chip-Blue (duino.lk)
ATMEGA328P-PU MicrocontrolleR	Rs.1990	ATMEGA328P-PU-Microcontroller-with-ARDUINO-UNO-R3-Bootloader
Push Buttons (2)	Rs.20	6x6x4mm Push Button Micro Switch | WWW.DUINO.LK
TOTAL	Rs.4455	

Table 1: Bill of quantities
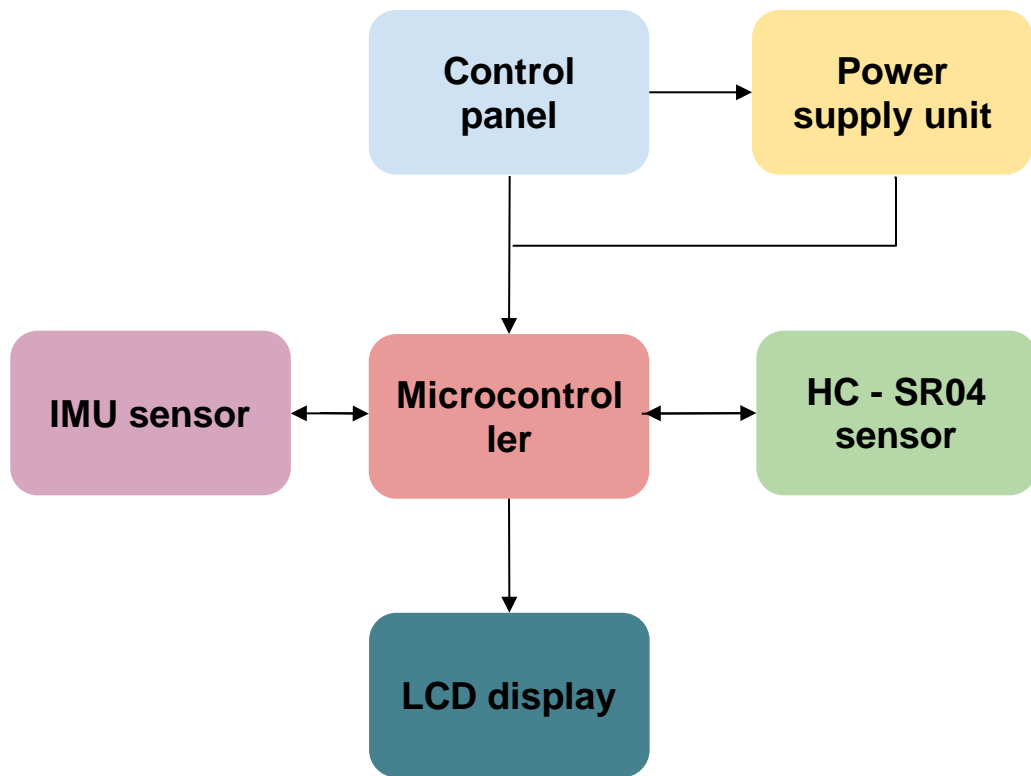
3 Product Architecture

Figure 1: Product Architecture

3.1 Control Panel: The device's control panel includes two buttons: one for powering on the device and the other for unit selection that allows users to switch between measuring units.

3.2 Power Supply Unit: The device is powered by a 12V power supply that is required to operate the ultrasonic sensor, gyroscope sensor, LED display, and microcontroller. The power supply is obtained by using two rechargeable 6V batteries.

3.3 Display: The device's display is a 16x2 LCD display that displays the measured height in the selected unit.

3.4 HC - SR04 Sensor: The device uses an HC - SR04 sensor to measure the height between the device and the floor.

3.5 Inertial Measurement Unit: The device also features a gyroscope sensor that is used to measure the orientation of the device and calculate the perpendicular height using the data from the HC-SR04 sensor.

3.6 Microcontroller Unit: The microcontroller unit controls all device functions, including height measurement and unit selection.

4 Design

4.1 User Interface (UI) and User Experience (UX)

The UI of the height measuring device is designed to be intuitive and user-friendly, consisting of a display and control panel. The control panel includes two buttons, including the power button and unit selection button.

The power button serves to turn on the device. The unit selection button allows users to switch between measuring units, while the LCD display shows the measured height in the selected unit.

In terms of UX, the device's design and functionality are intended to provide a positive user experience. The device is portable and easy to use, with a user-friendly control panel and intuitive display. Battery replacement is also simple and convenient, as it can be done by removing the casing behind the device.

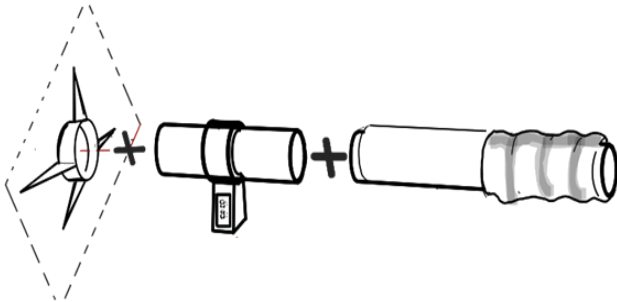## 4.2 Enclosure Design

4.2.1 Hand-drawn sketch

Figure 2: Initial Sketch

In our initial sketch, we designed the height measuring device as three separate units: the handle, the sensor and display unit, and a tripod-like component for maintaining perpendicularity to the wall. However, during our testing phase, we found that this design was not user-friendly, as users had to fix the three units together to measure the height accurately. Also, we found that the length of the device was too long, making it impractical to carry around and limiting its portability.
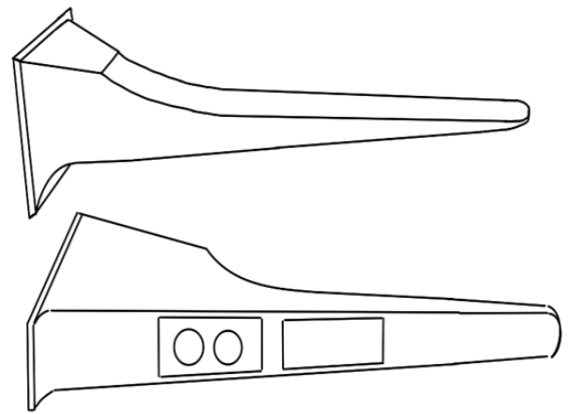

Figure 3: Final Sketch

As a result, we decided to redesign the device as a single unit that can maintain perpendicularity to the wall on its own. We also took into consideration the device's portability, and we were able to reduce its length by finding a more efficient way to use the device.

5 Marketing

5.1 Marketing Opportunities and marketing segments

- Our main marketing segment is medical clinics in both government and private hospitals, and medical centres. In medical clinics, the traditional way of measuring height is using a measuring tape or a stadiometer. Since it requires the assistance of a second person, it is time-consuming and inconvenient, and it is a waste of manpower. By using this product one can solve this since the product automatically displays the height of the patient.
- This product can be used domestically as well as in medical clinics. Height tracking is important in identifying certain disorders that affect growth and development, such as growth hormone deficiency or Turner syndrome. And BMI tracking is also important in identifying some diseases like diabetes B, coronary heart disease. Therefore, It is important to track anthropology measurements. By using this product someone can self-measure their height. And also, with the mobile application of this product, it is very easy to track anthropometric measurements and analysis them.
- With further improvements we are planning to develop a variant to measure any length, that can be used for various length-measuring purposes.

5.2 Marketing

We are going to market our product by targeting the marketing opportunities that have been mentioned above. After the product is tested for functionality and durability, we aim to get NMRA approval for our product. Thereafter, we aim to market our product mainly targeting medical clinics both government and hospitals. And we have planned to introduce our product for domestic usage through pharmacies.

5.3 Sales Strategy

Our main marketing segment is the medical sector. Therefore, we are trying to partner up with potential medical sales representatives, and through them, we are going to introduce our product to medical clinics, pharmacies, etc. Also, we are going to market our product through social media. That way we are trying to market this device to domestic users.

5.4 Services that we aim to provide in the sale

- User manual – A user manual for the device will be given to the users to get a clear understanding of the product.
- Product packaging – The product will be packed into a cardboard box that will contain the device which will be packed in bubble wrap, a user manual, and a warranty card.

5.5 After-sales services

- Maintenance – The device must be kept in a dry place at room temperature.
- Repair - In any instance of malfunctioning, it will be repaired free of charge during the warranty period. (Terms and conditions apply)

6 Task Allocation among the group members

Task	Name			
	Risini Kumarasinghe 210321X	Nadun Rajapaksha 210504L	Chathura Weerasinghe 210687X	Isiri Withanawasam 210732H
Product Designing (Overall)	✓	✓	✓	✓
Market Analysis	✓	✓	✓	✓
Circuit design and testing			✓	✓
PCB designing			✓	✓
Software designing		✓		
Enclosure designing	✓			
Safety and medical Concerns		✓		
Documentation	✓	✓	✓	✓
Budget and financial management	✓			
Testing	✓	✓	✓	✓
Setting up the final product	✓	✓	✓	✓
Marketing strategy and marketing	✓			

Table 2: Task Allocation