A HEALTH MONITORING SYSTEM WITH PROVISIONS FOR SETTING UP SMART ALARMS AND REMINDERS

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ABSTRACT: *Obesity as a serious health issue is on the rising trend worldwide. Various studies by scientists and researchers have found a relation between obesity and sleeping patterns of people. Waking up early have been found to have positive effect on health. Development of a health monitoring system has been proposed in the paper to tackle the said problem. The system consists of a custom made smart mat device powered by a Arduino unit which also includes Force Sensitive Resistor sensors to calculate the weight of the user. A companion application along with a Raspberry Pi unit will be used to monitor the alarm system and the entire user data will be transferred wirelessly between them through online cloud system.*

Keywords : Pressure Sensitive System, Alarm System, Reminder System, Weight Tracking System, BMI System, Cloud Data Storage, Arduino, Embedded System, Force Sensitive Resistor (FSR) System, Bluetooth Connection, Raspberry Pi 3.

1.INTRODUCTION

In today's fast paced world, people do not have time to take care of their health and often suffer from sleep deprivation. Irregular sleeping patterns have led to a lot of health problems among people. The time when people go to bed and wakeup have a tremendous impact on people's weight. Numerous studies have proven that people who sleep late at night are more likely to be obese than those who sleep early. Obesity is a problem worldwide which affects not only adults but also children. Waking up early and sleeping early reduces the risk of developing obesity among people. To solve this problem of irregular wakeup and bed times of people is what the paper hopes to accomplish. The system which is addressed in the paper is focussed on creating a health monitoring system which features setting up smart alarms and reminders. The alarms and reminders are set using a companion universal windows application. The system will also monitor Body Mass Index (B.M.I) of the user by calculating his weight using two Force Resistive Sensors (FSR) over a period of time.

User health data will be sent to the cloud and can be retrieved at any time and on any device running the windows application. User will be able to track his weight and make necessary lifestyle changes. The proposed system use a smart mat device consisting of FSR sensors for weight measurement connected to the Arduino Uno unit which wirelessly via Bluetooth connection sends the data to the Raspberry Pi 3 unit. The Raspberry Pi unit then wirelessly sends the data to Microsoft Azure cloud system which then further forwards and transfers this data to the universal windows application running on a device. The device can be a Windows Phone, Windows tablet computer, Windows laptop, desktop, etc. Thus the health monitoring system gets implemented to help reduce obesity among people.

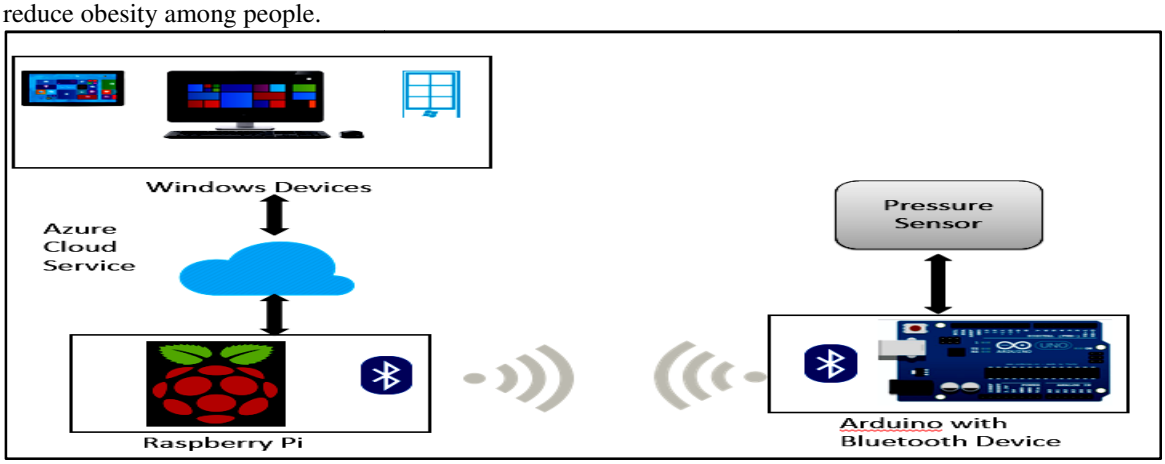

Fig. 1. Working of smart mat system

2. MOTIVATION

According to World Health Organization (WHO), worldwide obesity has doubled since 1980. There are more people living in those countries where overweight and obesity kills more people than underweight. Rise of obesity is not only seen in adults but also among children. In US, according to research, obesity is second only to tobacco in number of death causes each year. It has manifested into a serious problem. Obesity poses major health risks like shorter life span, type 2 diabetes, high blood pressure, heart disease, psychological problems such as depression, various types of cancer including breast, uterine and colon cancer, osteoarthritis, infertility in women, sleep apnea, etc.

Fig. 2. People suffering from obesity

There is a relation between obesity and sleep especially the time you go to sleep and wakeup. Sleeping patterns of a person has been observed to affect his/her weight. Research has proved that late night sleeping leads to increase in weight of a person. Going to bed early and waking up early has shown to reduce obesity among people and keep them healthy. We wanted to develop a system which would help to gradually reduce obesity among people and motivate them to maintain a healthy lifestyle. Our system successfully helps people in achieving their goal of living a healthy life.

Category	**BMI range – kg/m*2**
Underweight	16.0 to 18.5
Normal (healthy weight)	18.5 to 25
Overweight	25 to 30
Obese Class 1 (Moderately obese)	30 to 35
Obese Class 2 (Severely obese)	35 to 40

Table 1. WHO BMI cut off points

3. LITERATURE SURVEY

Paper Title	Author	Analysis
Analysis and Selection of the Force Sensitive Resistors for Gait Characterisation	1)Muhammad Faraz Shaikh 2)Zoran Salcic 3)Kevin Wang	This paper researches on choosing suitable FSR sensors for specific gait condition analysis.
A Wireless Smart-shoe System for Gait Assistance	1)AKM Jahangir A. Majumder 2) Ishmat Zerin 3) Chandana P. Tamma 4)Sheikh I. Ahamed 5)Roger O. Smith	A smartphone based system for gait analysis via a wireless smart-shoe is presented in this paper.
Flexible and Sensitive Foot Pad for Sole Distributed Force Detection	1)Morteza Amjadi 2)Min Seong Kim 3)Inkyu Park	Here a foot pad with very fast response to the pressure with good linearity and sensitivity is described.
Force-dependent Contact Area Excitation of FSR Force Sensor Utilizing Dome-shaped Rubber Element	1)Damir Krklješ 2)László Nagy 3)Kalman Babković	This paper proves the assumption of pressure distribution underneath the pressed dome shaped rubber element.
Development of a Wireless Electronic Shoe for Walking Abnormalities Detection.	1)W. Donkrajang 2)N. Watthanawisuth 3)J. P. Mensing 4)T. Kerdcharoen	The paper describes a system that identifies various walking postures of people..
How much information could be revealed by analysing data from pressure sensors attached to shoe insole?	1)Goutam Chakraborty 2)Tetsuhiro Dendou 3)Daigo Kikuchi 4)Kyohei Chiba	This paper shows that shoe insole with less number of pressure sensors can differentiate between activities such as walking, jogging, climbing up and down stairs.

Table 2. Literature survey

4. PROPOSED SYSTEM

1) The user creates an online account for using the windows application.
2) The user then uses his account to set up alarms and set reminders via the application.
3) The alarm and reminder data is then sent to Windows Azure cloud system.
4) The data from cloud system is then wirelessly transferred to Raspberry Pi 3 unit and stored in it.
5) When the alarm rings, the user in order to stop the alarm has to step on the smart mat device which include two Force Sensitive Resistor(FSR).
6) As the user is standing on the smart mat device, the force which he/she exerts on the FSR sensors is sent to the Arduino Uno microcontroller unit.
7) The data Arduino unit is sent to Raspberry Pi 3 unit via Bluetooth connection by using a Bluetooth module connected to Arduino unit.
8) The data received at Raspberry Pi unit is then converted to weight in Kg and using the weight and height information, BMI of the user is calculated.
9) The BMI information is then sent wirelessly to the cloud system and it is further forwarded to the windows application via internet so that the user can see the information on the application running device.

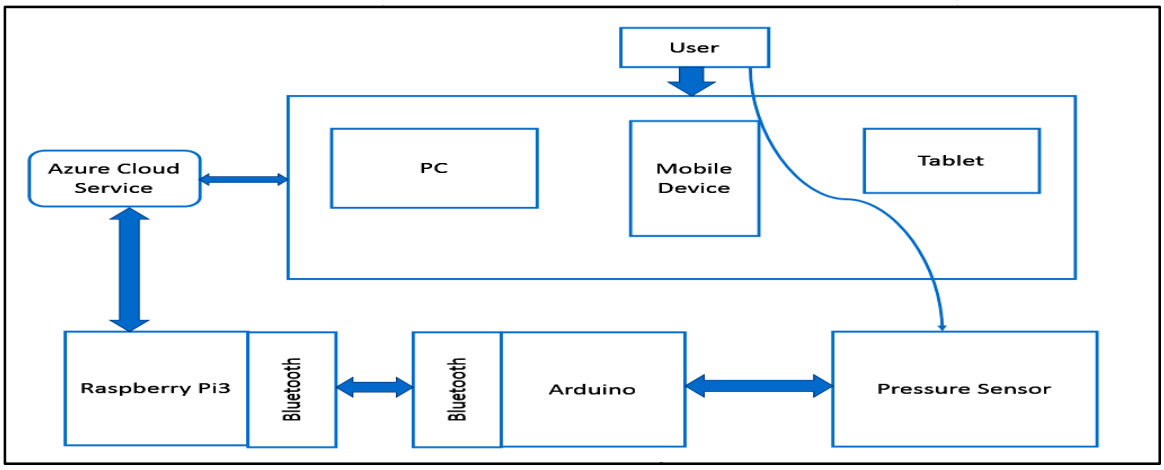

Fig. 3. Block Diagram

5. ALGORITHMS

5.1 Algorithm to convert FSR sensors values to weight

In this algorithm, the weight of the user is calculated using the derived constant. Both FSR sensors are properly calibrated first. After calibration, when the user steps on the smart mat device containing the FSR sensors, values from both sensors are taken and their average is calculated. This average value is then multiplied with the mathematically derived constant. The result of the multiplication operation gives the weight of user in kilograms.

```
// User_weight :: weight of user
// FSRreading :: readings from FSR sensors
public void Weight_Calc()
{
double User_weight,FSRreading;
Const perkg;
User_weight=convert.Todouble(FSRreading/perkg);
);
```

5.2 Algorithm to calculate BMI

This algorithm calculates the Body Mass Index (BMI) of the user. When the user stands on the smart mat device, values corresponding to the pressure exerted by the user on the FSR sensors is obtained to calculate the weight of the user. This weight data along with the height data given by the user is fed to this algorithm. The algorithm then produces BMI of the user.

```
// Convert.ToInt32() :: converts value from the text to integer form for calculation
// usr_weight :: weight of user
// height_feet :: height of user in feet
// height_inch :: height of user in inches
// height_metere :: height of user in metres
// bmi :: BMI of user
 private void BMI_calculate()
        {
           Double usr_weight, height_feet, height_inch,bmi,height_metere;
           usr_weight = Convert.ToInt32(user_weight.Text);
           height_feet = Convert.ToInt32(User_height_feet.Text)*12;
           height_inch = Convert.ToInt32(User_height_inch.Text);

           height_metere = height_feet + height_inch / 39.37;

           bmi = usr_weight / (height_metere * height_metere);
           return;
        }

       private void User_height_inch_Unloaded(object sender, RoutedEventArgs e)
```

```
{
   BMI_calculate();
}
```

6. CONCLUSION AND FUTURE SCOPE

In this paper, we have proposed a Arduino powered smart mat system connected to a cloud service to help people stay in shape by reducing their chances of becoming obese. The system will monitor a person's weight and calculate his BMI on a daily, weekly or monthly basis. The system will also show reminders of the user while using the smart mat. The smart mat system will wake user at predefined time. The user health information along with his reminders will be sent through cloud infrastructure and can be retrieved from any device running the smart mat application.

In future, we expect to test our system on more people. We intend to implement a text to speech system which will speak out the reminders of the users when they step on the smart mat system.

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