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Design and Development of Treadmill Controller with Wireless Mobile Health Monitoring System

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***Abstract*—** Humans used to workouts to burn calories to stay physically fit. For this purpose, Treadmills are extensively used inside gym as well as at home. The mechanical work done on the treadmill can be utilized to generate electrical power with minor machine modifications. This paper present a methodology to generate energy from various exercise equipment e.g. treadmill, bicycle. A microcontroller based automated electronic power controller has been developed. It controls and monitor generated power up to the storage device. MPPT algorithm along with CUK converter is implemented for better power efficiency. An independent health monitoring system has also been developed. It is a microcontroller based device which measures various health characteristics of the user. It also maintain database of health status reports for future use. For instant health status routine GSM based mobile SMS service used along with UART based PC communication. The designed system stores power generated while workouts and it also measures user health status continuously during workouts.

***Keywords*—** Treadmill Power Controller, Wireless Health monitoring, Power generation.

I. INTRODUCTION

A person use treadmill to lose his energy. As per the law of energy conversion, "Energy cannot be created nor can be destroyed; it can be converted from one form of energy to another form." Workout with the help of treadmill is very much popular in the urban areas where person are very busy with their daily life. The mechanical work done by human on treadmill can be stored for future use. By connecting a Dynamo (Generator/Alternator) with exiting treadmill or bi-cycle mechanical waste is converted to equivalent electrical power [1].

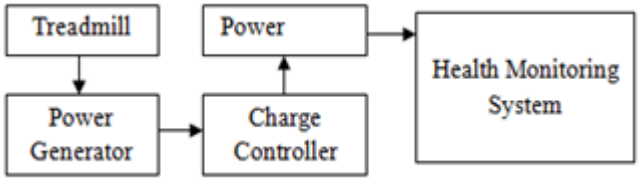

Figure 1. Block Diagram of Presented System

Figure 1 shows present work which helps to keep track health and power generation while working on treadmill. Generator sub system is used with charge controller circuitry to handle generated power. Storage unit is used to store generated power for future reference. Health monitoring unit works independently from the charge controller. It keeps tracking of human pulse rate while workout. This system also provides emergency support massage and alarm for the concern person.

This paper is organized in 5 different sections. It starts with Introduction as its first section. It shows the basic idea behind the paper. Second section deals with purpose and the significant of the designed system. It also discuss about the previously designed systems. Section III contain architecture and design methodology with flow chart for independent health monitoring and power generation systems. Section IV shows final designed product as the result and analyze it with real world testing. Section V concludes the feasibility, reliability, maintainability of the product for future implementation.

II. SIGNIFICANCE OF WORK

The purpose of present work is to develop an enhanced treadmill generator system to utilize human power for electrical power generation and to monitor user health related problems or issues. The treadmill machine provides a moving platform with a wide conveyor belt which consist of

two pulley one is drive pulley and other is idler one both of them are driven by an electric motor or flywheel through which we can also generate power with the help of dynamo by placing it at proper position. Regenerative braking of the motor can provide a large amount of power to the storage device [1] [2]. A person use treadmill to harness his energy. Mechanical work on various workout equipments is going to be waste unless we utilize this work for further use as to generate electrical energy. This energy can be used in home-office application depending upon demand.

It is also an important task to track user health status while workouts e.g. pulse rate, ECG signals, blood sugar etc [3] [4] [5]. For this purpose a controller has been designed which control and monitors the heart pulse rate and automatically saves the whole data to the mobile through GSM technology [3]. It helps us to make the records of the individual's health status in various situations for quantize analysis. The proposed system ensures that the person can achieve his fitness along with power generation with the help of developed treadmill controller and it also gives real amount of response to heart pulse rate through the output which is delivered on the mobile phone via GSM modem.

III. METHODOLOGY

Present work is divided into two different modules. One is used to monitor human heath working on treadmill and other one is used to monitor and store power generated by treadmill. Both the modules contain separate microcontroller working independent to each other.

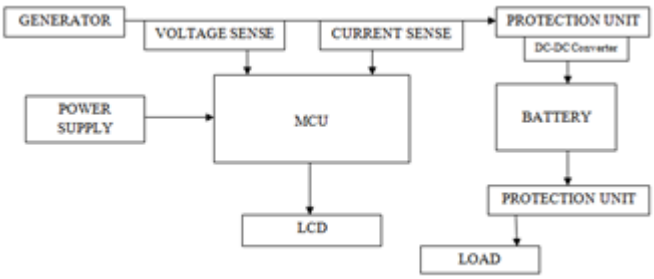

Figure 2. Power Controller Modules

Figure 2 shows power controller module for power generation and storage. PIC18F452 microcontroller is used with various protection relays. Microcontroller sense power generated by treadmill and converts it to the sufficient voltage level for battery charging. Maximum power point tracking algorithm is implemented with the help of microcontroller. For this purpose microcontroller provides duty cycle to both of the switching device of CUK converter. Short circuit, Reverse polarity, over charging and deep discharging protection is also implemented with the help of microcontroller. Status LEDs are used to show the status of microcontroller program and LCD is used to display real time generated power.

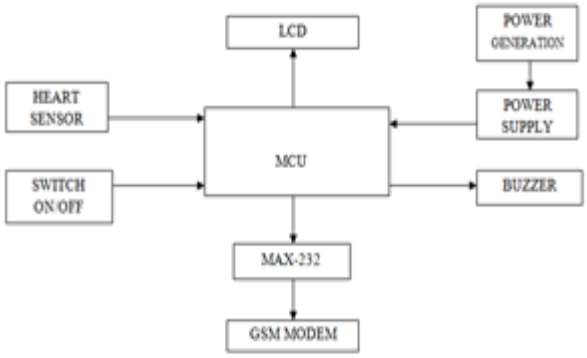

Figure.3. Health Monitoring System Modules

Figure 3 shows Health monitoring system module. AT89C51 microcontroller is used to interface Pulse sensor and GSM-900 module. Microcontroller reads value from the heart sensor and count human pulse rate. If any of desired condition occurs then it generates alarm for that user.

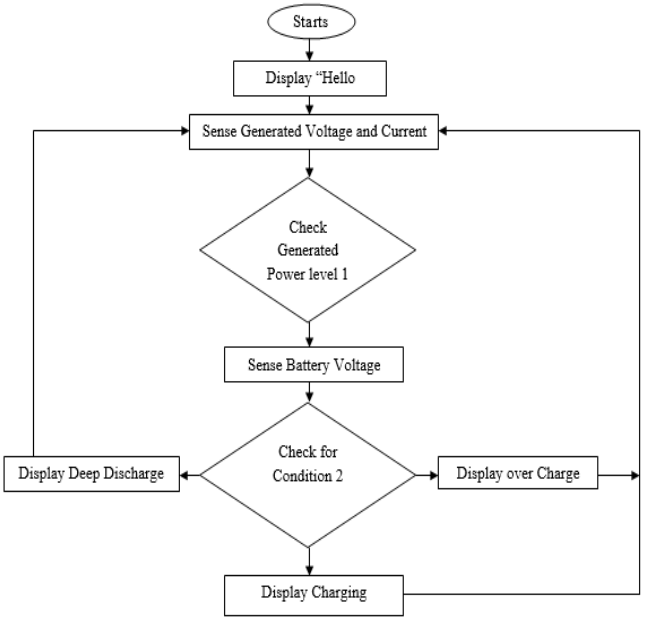

Figure 4. Flow chart for PIC18F452

Each microcontroller has a set of flow path which defines what operation microcontroller should under given circumstances. Figure 4 shows flow diagram for PIC18F542 microcontroller used in power controller module. Similarly

figure 5 shows flow diagram of AT89C51 used in health monitoring module.

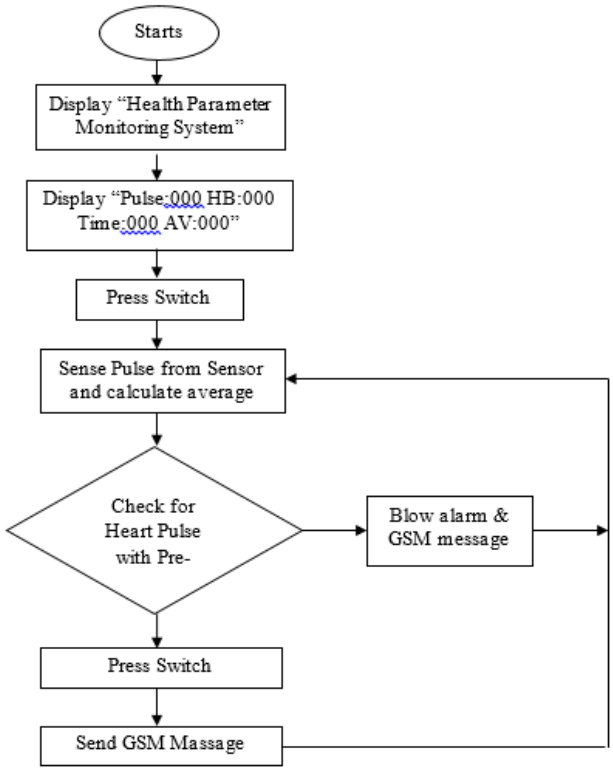

Figure 5. Flow chart for AT89C51

Some mechanical modifications have been done in pre-existing treadmills. For manual treadmill, a motor is directly connected with rotor via pulley. For motor powered treadmills, reverse braking mechanism is also implemented along with another dynamo. In both types of treadmills motor is directly associated with the power controller module.

Whenever system turns 'ON', it starts with power controller module. After initializing status LED and other peripherals the microcontroller stats to sense for input power. Microcontroller measure voltage and current of the generated power and changes duty cycle of both the transistors. These transistor controls working of converter as buck or boost. Microcontroller always maintains the input generated power up to the charging level of the storage battery for maximum efficiency. Now health monitoring module starts working and it keep measuring real time pulse rate of user. Whenever it detects any misreading or hazardous situation it immediately generate alarm and update all the concern personality about situation.

IV. RESULTS AND DISCUSSION

An embedded systems contains of various electronics modules connected to each other to perform some specific task. In this work a system has been developed for heath monitoring and charge controller of treadmill. Two different LCD's are used to show real time status of the program. Both are connected to two different microcontrollers independently. First LCD is used to monitor health related issues and other one is used to show generated power and status of the battery. Both Health monitoring module shown in figure 6 and power controller module shown in figure 7 are combined together inside a box as shown in figure 8.

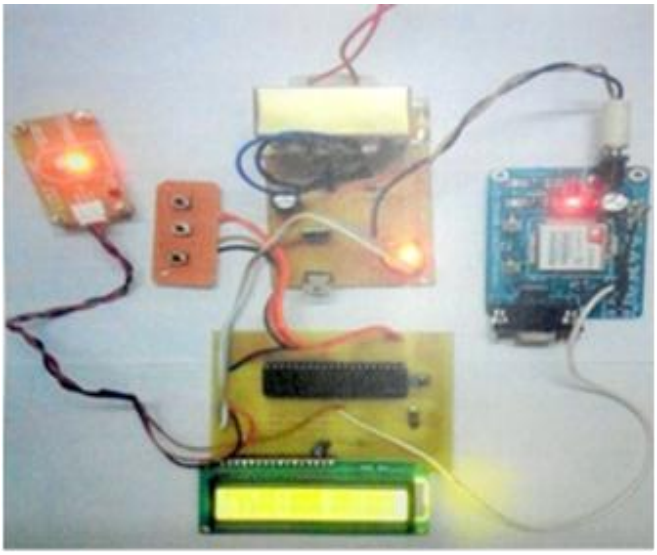

Figure 6. Health Monitoring

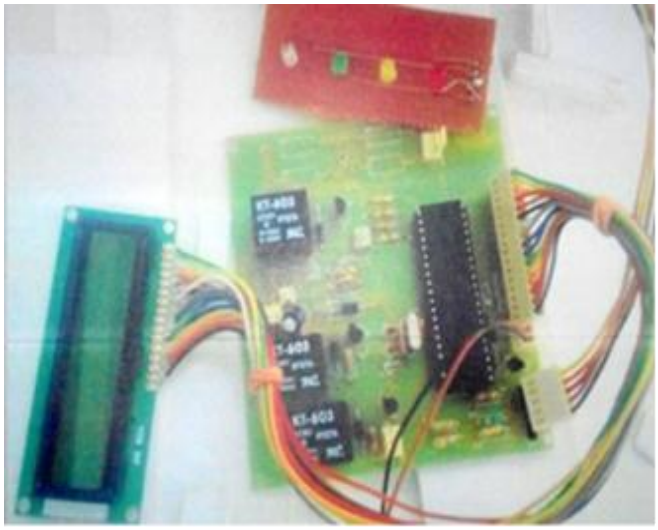

Figure 7. Power Controller Module

Figure 8. Final Product

A case study of 25-28 age group persons with different weight category has been done on mechanical treadmill. Graph 1 shows average pulse platform on various speed characteristics. 24V, 2.5Amp, 300 RPM Geared DC Motor is used for the prototype testing. This Motor is selected on the basis of condition as a person with weight 70Kg running with 16 kmph can generate nominal motor power capability. Power generated by the treadmill with the help of testing prototype is shown in Table1.

Graph 1. Pulse Rate on Treadmill during Workout

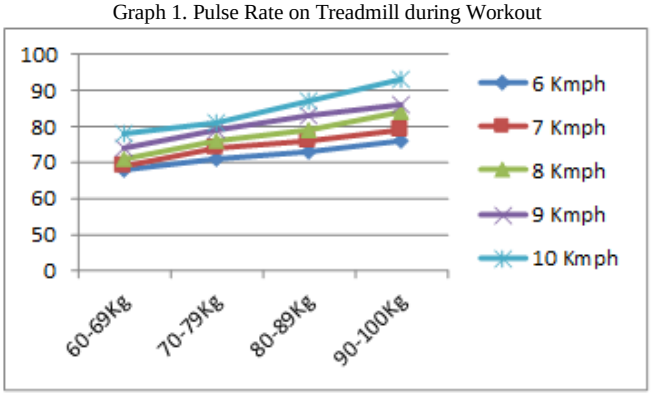

Table 1. Problem Generated by Prototype

Age Group		Avg. Power Generated (@ 9Kmph)	
Below 20	**<50Kg**	~12V	500mA ~ 1A
	50~70Kg	12V~14V	~ 1.2A
	>70Kg	~16V	1.4A~ 2A
20-40	**<70Kg**	~14V	700mA~ 1.5
	70~90Kg	16V~18V	~1.6A
	>90Kg	~20V	2A~ 2.4A
Above 40	**<60Kg**	~13V	650mA~1.4A
	60~80Kg	15V~16V	~1.6A
	>80Kg	~ 18V	1.8A~ 2.3A

V. CONCLUSION AND FUTURE SCOPE

Insufficient fuel, lacking of efficient management and lack of timely implementation of allocated money are the major problems of power crisis in our country. We can control over this energy crisis by utilizing very basic power generation capability of human lifestyle. Modern human is more conscious about his health issues. For this purpose they generally prefer to walk in the morning or evening. They should have some system to provide data about their dear one's health. The presented system can work with any domestic or professional treadmill facility. It shows about the health of the person along with it also used to generate energy from the treadmill itself. This generated energy can be utilized for better use. Further technical developments and government financial help can make this project a huge success future sustainable energy

The proposed project is very productive and cost effective. But there is always a room for improvements. The presented system is a basic model to represent concept and idea behind that. With the use of latest technology and invention designer can enhance efficiency and practicality of the model. There are two aspect of development in this model. With the help of 2 stages MPPT algorithms based power generation and better storage facilities power generation efficiency can be enhanced. Health monitoring module can be very much handy and user friendly with the help of android platform interface along with some other real time health measurement as blood sugar, body temperature, ECG reports etc.

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