



## IoT Based Human Power Generator and Fitness Analyzer

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**ABSTRACT:** As the search for renewable energy sources is emerging everywhere, innovative and interesting ideas for generating power are constantly being devised. Fitness conscious people try using various methods to burn their calories and stay fit. Gym equipment such as spin bikes or other equipment can be used but since it is difficult during this pandemic, in this project we are using a portable cycle to achieve fitness along with power generation which solves many problems arising due to the pandemic. It discusses the design and development of a method of exercising on a bicycle to convert the mechanical rotational power of human peddling to usable electrical energy. To check fitness, various sensors are attached to the person exercising, and with the help of the Wi-Fi module, the data is stored in the IoT based cloud. The app can be downloaded on our smart phones and fitness checkup can be achieved through the app using fewer components and much lesser cost which is the perfect solution during covid-19 pandemic.

**KEYWORDS:** IoT, Fitness Analyzer, Human Power Generator, MET, Health Monitoring Devices

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### I. INTRODUCTION

With the growing population, the dependency on fossil fuels is increasing and hence there is a search for alternatives renewable resources. Renewable power is a booming innovation as it brings down the cost, reduces the harsh effects caused due to pollution, and hence promises a greener future. This means that renewable sources are increasingly replacing fossil fuels. Also, as fossil fuels are expensive, the usage of renewable resources is considered a better option as it is cost-effective.

Regular exercises and physical activities contribute highly to a healthier lifestyle. According to a study conducted by ICMR – INDIAB in 2015[7], it reveals that the central obesity rate is 16.9% - 36.3%. The outcome of this high obesity rate[8] has indicated a deterioration in human mental health, an increase in the risk of heart diseases, type 2 diabetes, and some kinds of cancer. Fitness analysis plays a major role in monitoring our day to day activities and provides us with training needs and goals.

### II. HUMAN POWER GENERATOR AND FITNESS ANALYZER

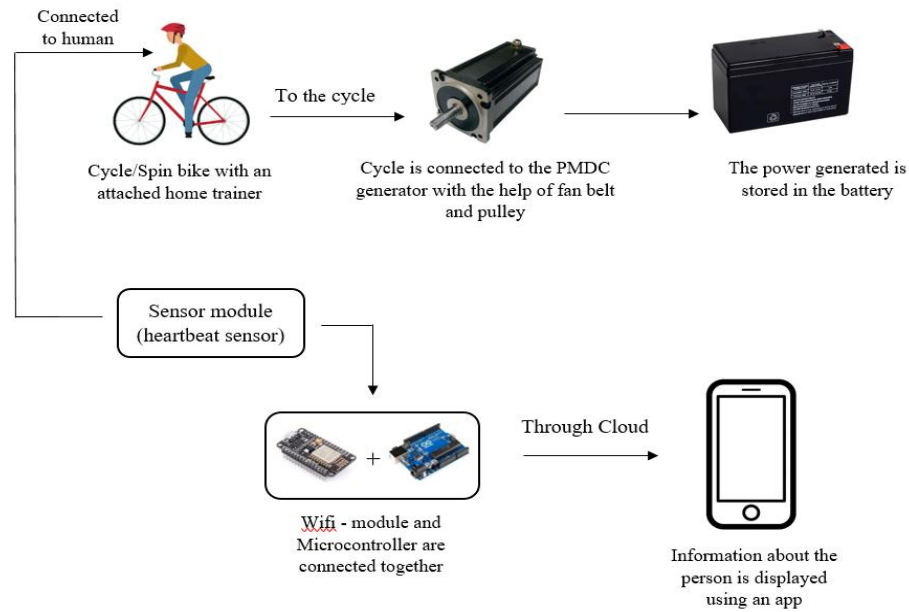
Power generation is the process of producing electric energy or the amount of electric energy produced by transforming other forms of energy into electrical energy; commonly expressed in kilowatt-hours (kWh) or megawatt-hours (MWh)[9]. Human power is a figure or energy that's produced from the physical body. It also can ask the facility (rate of labor per time) of a person. Power comes primarily from muscles, but heat is also used to do work like warming shelters, food, or other humans. Human-powered equipment is occasionally wont to generate, and sometimes to store, electricity to be used where no other source of power is out there. These include the wind-up or (clockwork) radio, pedal radio, and Gibson girl survival radio.

Physical activity is a voluntary body movement[10]. This is important for better mental as well as physical health and long life. Without proper maintenance of physical health, we are prone to many diseases that can affect our life span, and also this leads to laziness which in turn causes us to lack in many perspectives of our lives. Regular exercise and physical activity help to promote strong muscles and bones, lowers blood cholesterol levels, also the risk of falls. Staying active can also help you maintain a healthy weight, reduce the risk of type 2 diabetes, and also reduce the risk of cancer[8].

Therefore, to monitor our health, a fitness analyzer plays an important role to keep a track of our health, daily. In our project, Fitness analysis can be done within 10 minutes with the help of a polarized heart rate monitor. It does not require any external equipment to do it. It also gives VO<sub>2</sub> max level, heart rate and BMI index, fat%, and other parameters.

### III. PROPOSED METHODOLOGY

A block diagram of the proposed methodology is represented in Diagram 1. With the peddling of the cycle, the PMDC generator also rotates with the help of the power delivered by the wheel. The output of this generator is AC and the input given to a battery/UPS should be of the form DC and hence this conversion can be done with the help of a rectifier. This power is generated and can be stored in a battery and can be used for various household applications. A fitness test is possible at home with less time and day to day fitness monitoring is also simplified.



**Diagram 1.** Block diagram of the proposed

The person, before sitting on the bicycle has to attach the heartbeat sensor and also give his personal information in the app. During exercise, with the help of a Wi-Fi - module, all the data gets stored in the cloud storage and hence gets displayed on the app at the end of the exercise. The mobile application is created using MIT App Inventor[11]. The parameters to be measured are fed along with the formulas to give accurate measurements for various parameters required.

MIT App Inventor is a visual programming environment using which a mobile application will be built for the data analysis. It is a block-based programming which is easy to learn and code. The formulas[12] of various parameters calculated by the application is detailed in Table 1.

SI.No	Parameter	Formula	SI Unit
1	VO <sub>2</sub> Max Level	$Vo_2 \text{ max} = 15.3 * \text{beats}$	mL/(kg.min)
2	BMI test	$BMI \text{ test} = \text{weight} / (\text{height} * \text{height})$	kg/m <sup>2</sup>
3	Body Fat Test	$FAT \% = (1.20 * \text{bmi}) + (0.23 * \text{age}) - (10.8 * \text{gender}) - 5.4$ ; where for male=1, female=0	%
4	MET Test	$\text{Calories/hour} = MET * \text{weight in kg}$	mL/kg/min
5	Calories Burned	$\text{Calories/hour} = MET * \text{weight in kg}$	kcal

**Table 1.** Parameters and formulas

### IV. RESULT AND DISCUSSION

#### A. VO<sub>2</sub> Max Level

VO<sub>2</sub> max is that the maximum rate of oxygen consumption measured during incremental exercise; that's, exercise of accelerating intensity. Maximal oxygen consumption refers to the person's oxygen

consumption during an event of intense body workout/exercise. The more is the oxygen consumption when the body is physically under stress, the more is the energy produced. Calibration is required for this parameter due to high variability per minute.

#### **B. BMI Test:**

Body Mass Index or BMI is a simple calculation using a person's height and weight. The idea to measure body fat came with observed increasing obesity in societies. BMI is considered appropriate for population studies and inappropriate for individual evaluation. This measurement can be made periodically and doesn't require a continuous monitoring.

#### **C. Body Fat Test:**

Body fat testing is a test that is used to check how much body fat or fat percentage a person has. It is usually done to find out if a person has too much or too little body fat. This test is one of the ways to measure healthy weight. People who are trying to become more fit and lose weight sometimes use this test to check for changes in their body fat levels.

#### **D. MET Test:**

MET's test or metabolic equivalents of task is a type of fitness test that uses a number or score to measure a person's health risk and even predict mortality rates. The test takes place on a treadmill/spin bike or in this case a portable bike in a controlled environment. It is very simple and easy and does not take more than 15 minutes.

#### **E. Calories Burned:**

The calories present in the food consumed being converted into energy during physical activity. This conversion of food and drinks into energy is a biochemical process named Metabolism. For the calories to be burned from all the carbohydrate consumption and the stored fat, the body requires oxygen.

## **V. CONCLUSION**

The proposed methodology can be used to produce the power from human energy and to analyze fitness at a lesser cost and time. This will be most beneficial to society especially to the people who are health and fitness conscious. In this paper, a power generation cum fitness analyzer has been designed and developed based on an Android platform. It is convenient for users to use this system as they can connect it to their smartphones and get real-time streaming data. The system can also extract various parameters of a person such as Calories burned, VO<sub>2</sub> max level, heart rate, MET, BMI. Power, battery Status, Speed, Workout Time can also be estimated using the app and necessary measurements and health monitoring can be performed.

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