

Playing Music Based on Heartbeat

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Abstract: Music is an important part of many people's lives. Whether recalling good times or bad, most people remember a certain song that was playing in the background. Music is tied into human emotion and can make a person happy, sad, anxious or self-confident. Music is also connected to physiological responses within the body, including heart rate. The relationship between music and heart rate is complex and can be beneficial to health, especially for those who experience heart problems and chronic pain. A person's heart rate changes while listening to music, but whether the heart beats faster or slower depends on the tempo of the music. Today with the explosive growth in amount of available digital music, music recommendation systems have become an important research area. Currently, there are two types of architecture for music recommendation systems. In type one if user wants to get desire music services for recreation, he/she needs to interact with the music system explicitly to browse and select the desired music services from the provided options. The system can recommend music based on the user's explicit interaction with the system. New technological advances may make it possible to match a person's musical library to her heart rate. The system cannot only recommend a music playlist based on the user's music preference but also the music playlist is generated based on the user's heartbeat. This transfers the user from the abnormal heartbeat state to the normal state.

Key Words: Heart rate, physiological responses, blood pressure, music and sensor.

1. INTRODUCTION

Today, it is common to find people listening to music during many daily activities. The reasons for which they are listening to music and to what type of music they listen to varies with personal preference. The effect of music on an individual is an increasingly researched topic, especially in regards to emotional response, relaxation, and anxiety. One study found that while listening to a Mozart sonata, participants' tension increased as tempo increased and decreased with moderate tempos (Krumhansl 2002). It is also suggested that music increases learning ability and memory through different interconnected processes in the brain (Trappe 2010). The increasing number of studies on the effects of music on emotion and memory have led to further research at the cellular level. Several recent studies suggest that music has a number of effects on participants at the physiological level. These studies provide evidence that

leads some researchers to recommend music as a form of therapy. Trappe (2010) found that patients with anxiety, pain, stress, depressive syndromes, and sleeplessness will benefit the most from listening to classical music as it caused both heart rate and blood pressure to decrease. This same study suggested that hip hop and rap music, associated with fast tempos, cause negative influences on patients by increasing their blood pressure and heart rate. A similar study by Iwanaga and Youko (1999) showed that listening to music reduces patients' anxiety pre-surgery as measured by their systolic blood pressure and heart rate. It was also found that certain types of music, like fast and slow tempos, have different effects on physiological measurements during exercise. In one study, participants preferred higher tempo music while exercising, shown by an increase in physiological arousal (Karageorghis, Jones, and Low 2006). Edworthy and Waring (2010) observed the effect of slow versus fast tempo music and found a significant difference between 4 the heart rate of participants who exercised while listening to fast-loud music versus slow-quiet music. In the same study, researchers compared the effects of slow versus fast music and found significantly higher heart rates in patients who exercised while listening to fast-loud music versus slow-quiet music.

According to all of these studies, music can have an effect on the physiological measurements of a person who is experiencing an increase in blood pressure or heart rate due to anxiety or physical exertion. Following these studies, the current study expects that slow tempo music will return participants' heart rates to baseline faster than fast tempo music. This is based on findings that fast tempo music is shown to increase physiological arousal and slow tempo music is shown to relax a patient. The physiological arousal of participants will be measured through heart rate, and blood pressure. Monitoring the heart rate will show the amount of time needed for participants' heart rates to return to baseline while listening to different types of music. In agreement with the literature, it is expected that classical music will relax participants faster than fast tempo music. The purpose of this device is to reduce the heart rate and blood pressure by music in panic situation. It has been reported that music showed consistent cardiovascular and respiratory responses with different styles in most subjects, in whom responses were related to tempo and were associated with faster breathing. Fast music caused increases in blood pressure, heart rate and breathing rate, and reduced bar reflex sensitivity. Slow music, on the other

hand, caused a significant fall in heart rate and breathing frequency compared with the baseline. The responses were qualitatively similar in musicians and no musicians and apparently were not influenced by musical preferences, although musicians did respond more.

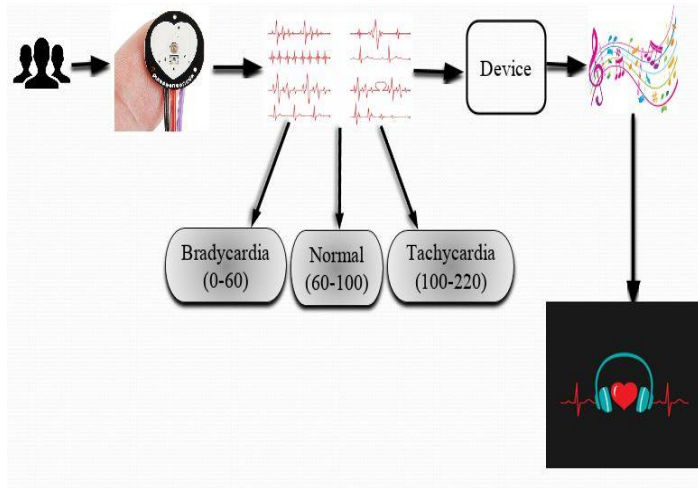


Fig -1: Block diagram of monitoring the heart rate and play music

2. MONITORING OF HEART BEAT AND MUSIC TO TUNE THE HEART RATE

Heart rate, commonly known as pulse rate, is the number of times the heart beats per minute. A normal heart rate depends on the individual, with age, body size, fitness level, heart conditions, whether the person is sitting or standing, medication and even air temperature. The designed system will give the details of heart rate and play music not only on user preference but also play music automatically.

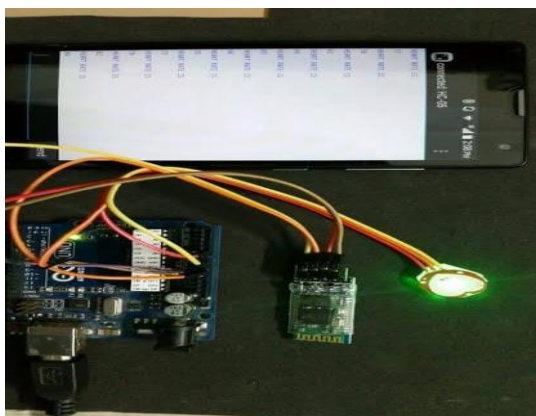


Fig -2: Device to monitor the heart rate

Everyone has a normal heartbeat rhythm. The rhythm varies from person to person. For a healthy person, his/her heart at rest beats about 60 to 100 times per minutes (age 18 and over) or 70 to 100 times per minutes (age 6-18). If his/her

heart beats fast or slow and the rhythm is disrupted, it may cause serious health problems such as lightheadedness, dizziness and fainting, etc. In the literature, music is used to keep a person's heartbeat at normal range. Knight and Rickard revealed that relaxing music attenuated blood pressure and heart rate after a stressful task; moreover, the level of subjective anxiety was reduced after the presentation of relaxing music. However, with technology improvements in networks, Storage, portability of devices, etc., personal accessible music collections have grown exponentially in recent years. This situation makes it difficult for users to browse and discover their favorite music from the vast amount of music collection by themselves. As an alternative, music recommend systems are being pursued to recommend users preferred music without "unnecessary" user explicit inputs. Much work has been done on developing music recommendation systems over the last decade. The interest in this area still remains high because it constitutes a typical problem rich recommendation application, and because of its promising commercial prospects that help the listener to find preferred music or promote new music to the listener. This lower/uplift the user's heartbeat back to the normal range with the minimum time cost; if the user's heartbeat is normal, the system generates a user preferred music playlist to keep the user's heartbeat within the normal range.

Audio Shield: The Arduino UNO is a low-end microcontroller that does not contain a digital to analog convertor (DAC) but to play the music the output should be in the analog format.

User Heartbeat Model: Heart rate is a measure of the number of heart beats per minute. For a child (age 6-18), his/her normal heart rate at rest is 70-100 beats per minute. For an adult (age 18 and over), his/her normal heart rate at rest is 60-100 beats per minute. If the heartbeat rhythm is disrupted and is beating lower than 60 (age 18 and over) or 70 beats per minute (age 6-15), it is called a bradycardia. A slow heart beat may cause dizzy spells, blackouts, breathlessness or tiredness. If the heart beats higher than 100 beats per minutes, it is called a tachycardia. When the heart beats rapidly, the heart pumps less efficiently and provides less blood flow to the rest of the body, including the heart itself. The increased heart rate also leads to increased work and oxygen demand for the heart (myocardium), which can cause a heart attack (myocardial infarction) if it persists. This occurs because the decreased flow of necessary oxygen to the heart causes myocardial cells to begin to die off. From the above description, then, for each age group, we can model three heartbeat states: tachycardia (100-220), normal (60-100 or 70-100) and bradycardia (60-0 or 70-0).

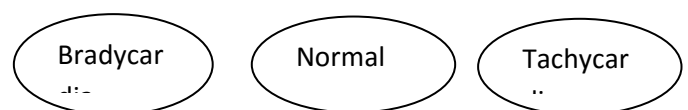


Fig -3: Healthy heartbeat mode

Change of music according to heart rate: The objective is to use music to tune the heart beat in order to enable the user to utilize his energy better during work out or any other physical activity. The output from the pulse sensor will input on the A0 pin header on the Arduino. The raw data from the device can be seen using the software sketch and the user's heart beat per minute (bpm) is obtained. Once the bpm is obtained, the system is programmed to compare it to the optimal rate. If it exceeds the limit or drops below, a suitable track is played accordingly in order to bring back the heart rate to the optimal value.

Arduino: The output from the pulse sensor will be input to the A0 pin header on the Arduino, and raw data from the device can be seen using the software sketch. The next step is to connect the Arduino to the play music from app.

Heart Beat sensor: The heartbeat sensor is based on the principle of photo plethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region). In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses.

There are two types of photoplethysmography:

Transmission: Light emitted from the light emitting device is transmitted through any vascular region of the body like earlobe and received by the detector.

Reflection: Light emitted from the light emitting device is reflected by the regions.

Working of a Heartbeat Sensor

The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a photodiode. The heart beat pulses cause a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate. This signal is actually a DC signal relating to the tissues and the blood volume and the AC component synchronous with the heart beat and caused by pulsatile changes in arterial blood volume is superimposed on the DC signal. Thus, the major requirement is to isolate that AC component as it is of prime importance.

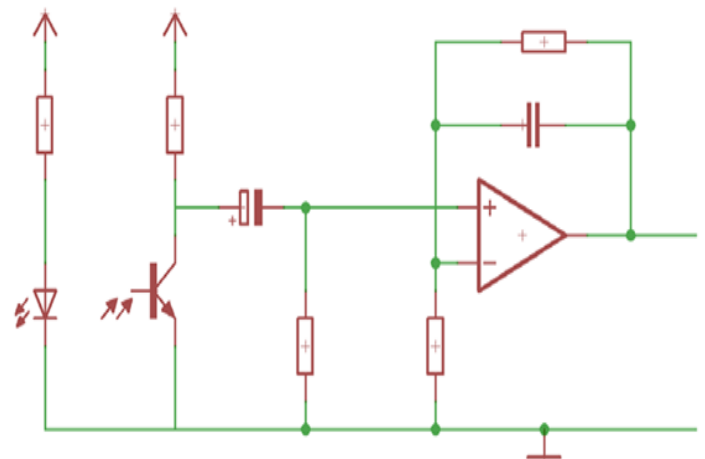


Fig -4: Heartbeat Sensor

To achieve the task of getting the AC signal, the output from the detector is first filtered using a 2 stage HP-LP circuit and is then converted to digital pulses using a comparator circuit or using simple ADC. The digital pulses are given to a microcontroller for calculating the heart beat rate, given by the formula-

$$\text{BPM (Beats per minute)} = 60 * f \text{ Where } f \text{ is the pulse frequency}$$

Music Player App: A media player is a computer program/software for playing multimedia files like audios, videos, movies and music. Media players commonly display standard media control icons known from physical devices such as tape recorders and CD players, such as play, pause, fast forward, back forward, and stop buttons. In addition, they generally have progress bars (or "playback bars") to locate the current position in the duration of the media file.

User Preference Playlist: If the user heart rate is normal user can select music based from set of music in the playlist. Many run mobile apps, using a mobile operating system and Bluetooth connectivity. Some device function as portable media players, with FM radio and playback of digital audio and video files via a Bluetooth or USB headset.

3. EXISTING MUSIC RECOMMENDATION SYSTEM

New user heartbeat and preference aware music recommendation system. It is a user-to-user based recommendation system which transfer the user heart rate from abnormal heart beat to normal heart beat with minimum time cost. Music is tied into human emotions and can make a person happy, sad, anxious or self-confident. It is connected to physiological responses within the body, including heart rate. Research reveal that to complement a user's heart rate set of playlists give music preferences to select music. This is not applicable when user is in panic situation or other circumstances such as heart rate varies automatic music helps human to make calm and relaxed.

New technological advances make it possible to match a person's heart rate to music. Monitoring the heart rate can play music tempo according to the heart rate.

4. PLAYING MUSIC BASED ON HEART RATE

The service could automatically start playing pumping music when it is time to go for a run or peaceful ambient track for when sleep is required or in the panic situation. A motion sensor and heart rate monitor could be used to select tracks and playlists that suit your mood and your movement. What might be the perfect tune for dozing in the sun, for running along a stormy beach or, perhaps, the soundtrack to the first flush of true love or, in the panic situation? A new feature being discussed by the music service could use sensor's measure their heart rate and then use that to select appropriate music. The more data can collect on listener habits, the better the recommendations its algorithms can produce. As well as music, motion, heart rate, and temperature, it could start to monitor sleep patterns.

1. Creating music player

A music player is created with set of songs in the playlist. The music in the playlist can be played in two ways (1) if the heart rate of human varies heart rate is integrated with playlist such that automatic music is played to the user (2) if heart rate user remains constant music is played based on user preference.

2. Monitoring Heart rate

This module acts as the starting input acquirer where the heart rate is acquired from the human body (through the heart rate sensor). The device we are developing will consist of pulse sensor which is used to get ECG signal from the human body at the real time. These rates contain noise and are called as raw heart rate. Working with such signals may generate a lot of errors hence we need to remove noise from them. For this purpose, these signals are fetched to the preprocessing unit for processing.

3. Extraction and Interpretation

The input to this phase is the noiseless heart rate. The irregular beats are found using this feature. If the heart rate is found to be irregular, it is classified into Arrhythmia class, else into the Normal class. The output of this module is either of the above classes.

4. Music Therapy

Music is integrated according to the heart rate of human. Music is played automatically when user has abnormal heart rate to complement it to normal

rate. If user has normal rate music is played according to user preference. Here, the music appropriate Indian classical musical raga will be played from smartphone of the patient

1) If the patient has a past record of 'Asthma' then music in raga "Malhar" will be played.

2) If the patient has a past record of 'Hypertension' then music in raga "Todi" will be played and if the patient has a past record of 'Low Blood pressure' then music in raga "Malkauns" will be played.

3) If the patient does not lie in the above-stated categories then the music in raga "Yaman" will be played for some duration of time (probably for 5-6

minutes). In case that the patient's stress does not get reduced (i.e. heart rate does not get reduced to the normal range), then music in raga "Darbari Kanada" will be played.

5. FUTURE ENHANCEMENT

New technological advancements can be developed such as facial expression and mood detections based on emotions of human. Since, music is tied into human emotions extracting the required input from human face can now be done directly using a camera. This can deduce the mood of an individual analyze the image properties and determine the mood of the user based on certain file properties so that they can be added to the playlists according to the mood.

6. CONCLUSION

Music is used more and more as a therapeutic tool, because all subjects, whether musically trained or not, respond in a similar manner. Music is a combination of frequency, beat, density, tone, rhythm, repetition, loudness, and lyrics. Different basic personalities tend to be attracted to certain styles of music. Energy block patterns can intensify, reduce, or change the natural inclinations of a person's identity. Music influences our emotions because it takes the place of and extends our languages. This application help to play music automatically that suits your mood. In panic situation it helps to control your heart rate to normal rate by music.

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