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MOBILE DETACHER USING A HEART RATE MONITORING SYSTEM

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ABSTRACT

Mobile phones are the most effective devices used for communication and are playing a vital role in every human being's life. Most of the mobile users are addicted to mobile phones. Superfluous use of mobile phones is interconnected with undesirable effects on human health. The best way to restrict the user from using the mobile phone unnecessarily is to limit gaming. Since Heart Rate (HR) is a well-being parameter generally used as a marker describing the autonomous nervous system functionality, it can be employed to evaluate the player condition. For the purpose of player condition estimation, a wearable device has been designed and utilized for the calculation of HR and transmission of HR readings to the mobile game application. The Mobile Game Application has been designed in a way to process the HR values and evaluate the screen time of the gaming app. If the application records an abnormal heart rate along with exceeded screen time, then the application will generate an alert message followed by an automatic termination of the game and sends a message regarding abnormality to the prescribed mobile number.

KEYWORDS: *Mobile addiction, gaming, heart rate, player condition, screen time, alert message*

I.INTRODUCTION

Mobile phones have become an indispensable part of our daily communication and a basic need for us. Mobile Phones are intelligent enough to do many things. Though the fundamental uses of the mobile phone are to make calls and to send messages, it can be used for numerous tasks, for example, to play games, browse data, capture photos, and many more [1]. The wide spectrum of beneficial activities associated with the mobile phone made most of the Smartphone users prone to exaggerated use of mobile phones, also called mobile addiction. Instead of using the mobile phone for their benefits, most of the users, especially students are wasting most of their time indulging themselves in unproductive works like playing online or offline games, listening to songs, spending many hours on social networking sites, sending antagonistic messages, watching videos [3].

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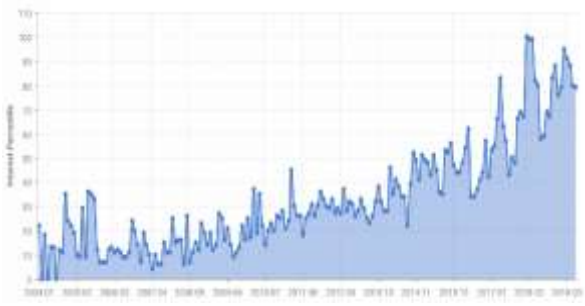

Fig.1. Phone Addiction over time (2004-2019)

Extreme usage of mobile phones has raised the problem of health risk [2] and this risk may vary from person to person [4]. Non-ionizing radiofrequency electromagnetic waves are ejected by mobile phones. A research work discloses that the probable consequences associated with the electromagnetic fields may include disorders of the nervous, immune, cardiovascular, or carcinogenic systems [5]. The most common symptoms of mobile addiction are sleep disorders, vomiting, excessive fatigue, palpitations, impaired concentration, digestive disorders, generic dermatological symptoms, dizziness and headaches [6]. Over a long-time use, it can cause DNA damage, affecting genes, membrane function, and signal transduction.

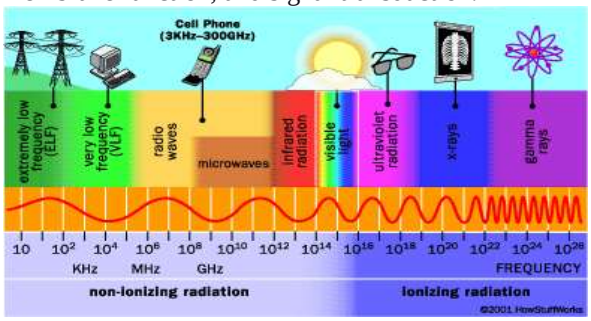

Fig.2. Electromagnetic spectrum

Since the effects of the outrageous use of mobiles are evident and detrimental, it has become essential to limit mobile phone usage. One of the best ways to regulate the amount of time being spent on the phone is to restrict the amount of time spent on gaming apps. The time one should spend on their phones with minimal harm differs from person to person based on their physical health, age, gender, etc. Generally, people who are inactive and spend more time on mobile phones have high resting HR, whereas physically active people have lower heart rates. Therefore, Heart Rate analysis is employed to categorize the ANS imbalances due to the overuse of mobiles.

AGE SPAN	HEART RATE (bpm)
Less than 1 month	120-160
1-12 months	80-140
12 months-2 years	80-130
2-6 years	75-120
6-12 years	75-110
More than 12 years	60-100

Table.1. Normal Heart Rate values of different age groups

In this work, we have developed a heart rate monitoring device [7-15] which efficiently calculates HR of the user and transmits these reading to the designed mobile game application via Bluetooth module. The calculated HR values are used to determine the user's heart condition [16]. The designed mobile application processes these HR values and screen time in the background and will generate an alert message followed by automatic termination of the game if any abnormality in HR values is encountered with exceeded screen time.

II. LITERATURE SURVEY

A comprehensive overview of the literature which helped in the evolution of this concept is mentioned in this section.

Suthashini Subramaniam, et al. [1] evaluated Mobile addiction disorder among 135 students. To determine the impact of mobile phone usage on students and to study the factors which can determine the addiction of mobile phones, the Smartphone Addiction Inventory (SPAI) which consists of 26 items in it is used. Exploratory Factor Analysis (EFA) was used to study the underlying connection between 26 items and the students. This paper leads to represent that addiction towards smartphones among students is average.

Katsuki Yasudomi, et al. [2] have determined App restriction performs which is one of the key options of digital medicines for smartphone addiction. The results of the paper show important variations in each psychological and activity aspect between those people who used the app restriction perform and people who didn't. However, the app restriction function is more effective for people who are tuned in to smartphone addiction.

Sevil Akbulut Zencirci, et al. [3] have proposed the problems of mobile phone addiction which were analysed making use of the Short Version of

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Smartphone Addiction Scale (SAS-SV). This SAS-SV consists of 10 things with sixfold Likert varieties. If the score was appropriate to normal distribution then the score was computed by exploiting the Kolmogorov-Smirnov test otherwise by Mann Whitney U, Kruskal Wallis analysis. The Hierarchical multilinear regression analysis used to define the unrelated variables influencing the SAS-SV score. 71.2% of scholars declared to own health issues associated with exploitation smartphones.

Sándor Csibi, et al. [4] have presented the common symptoms of mobile addictions. The hypothesis was appraised deploying data collected from 1603 people representing numerous age groups. A multivariate analysis of variance, on the various parts of the SABAS with gender and age being the categorizing factors, was accustomed to check the hypothesis. This paper reveals that mostly school children and youth are being affected physically and mentally due to mobile phone addiction.

Anna Koziorowska, et al. [5] have clearly explained the consequences of electromagnetic waves on human health. The electromagnetic field affects the nervous system and the immune system. Affecting the nervous system will result in harm to the extent of neurons, will harm the conjunction, will result in changes within the neural structure and state of mind. However, the results of the analysis demonstrate radiation will have both positive and negative effects reckoning on the physiological standing of the cell it operates on.

Krzysztof Przystupa, et al. [6] have illustrated the way the human body reacts to electromagnetic radiation (EMR). To indicate the range of fatigue and headache, conversation time per day in mobile phones is calculated. The experimental studies reveal that the phone owners complained of headaches, dizziness, state of mind, a sense of heat because of the EMR created by mobile phones.

Aboobacker sidheeque, et al. [7] have developed a system that supervises heartbeat and detects Heart attack using the IOT. The microcontroller processes the data acquired by the sensor and communicate them over Internet. Upon setting the normal and abnormal levels of heartbeat, monitoring commences. When the patient's heartbeat becomes abnormal, the system transmits a caution message regarding heartbeats and predicts the possibility of heart attacks.

Mohammad Wajih Alam, et al. [8] have proposed a body temperature and heart rate measurement system using temperature sensors and fingertips. Using optical technology, the blood flow through the finger is decided. The device shows accuracy in heartbeat measuring, even beneath extreme physical activity for real signals. The processed data of the patient is communicated to doctors via GSM module for patient monitoring and health care.

Kuala Lumpur, et al. [9] have proposed completely different strategies to measure the heart rate of an individual and an alert message to intimate patient's condition. During this analysis, it's shown that the heart rate may be measured by the observance of the heartbeat of personal exploitation specialized medical devices. The patient with lethal heart disease, are kept under supervision endlessly. The heartbeat is detected using the PPG technique and will send an alert message to physicians and patient's relations via SMS if any irregularity in heart rate occurs.

Faiza Jibril, et al. [10] have presented an efficient device which is capable of monitoring and detecting the heart conditions. In this device, a pulse sensor is employed to collect the pulse signal. The device identifies the heart condition once the calculated BPM of the person is available. GSM module is used to transmit the heart condition to the prescribed mobile.

Haziq Kamarul Azman, et al. [11] have developed a low-power HRV Acquisition chest strap. An acquisition concept, permitting the uprooting of HRV data expeditiously by imitating a modified time-varying threshold IPFM model, was conferred. The comparison was made on ECG to verify the thought. Sampling rate reduction technique was used to optimize the use of power.

Sani Abba, et al. [12] have designed an IoT-based heartbeat rate monitoring system for analytics and to safeguard people's health using efficient data acquisition, data collecting 14 technologies. This system uses a heart rate sensing element for information procurement and a microcontroller for data processing. The processed information is transferred to the Internet of Things platform to perform additional analysis.

Minal Patil, et al. [13] have designed a wireless belt that unceasingly monitors heart rate and temperature. The data sensed by the pulse sensor, temperature sensor is used by the microcontroller to detect the heart condition of the user and also upload the data processed to the cloud. A caution message will be sent to the number prescribed in the system when any abnormal heart rates are recorded.

Shriya Akella, et al. [14] have implemented a pulse observation gliding joint band and notification system. This device has been developed to endlessly monitor a patient's pulse and informs the person on his/ her mobile employing a real-time database-enabled push service. The microcontroller endlessly enters the processed data to the database. In case of any irregularities, this system uses webhooks to alert the user's family or friends about the user's condition.

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Arpita Ghosh, et al. [15] have proposed a Heart rate monitoring system which enables SOS messaging and also provides call facility. The whole work primarily has 2 elements Tx section and the Rx section. The transmitter section calculates the heart rate of the user and transmits a string regarding the heart condition based on the calculated HR values. The receiver section receives the transmitted string and decides on whether to make a call or to send a message or to do nothing. The results have cost the connectivity range, which might be improved.

Erika Abe, et al. [16] have developed a new game controller system. This system monitors the player HR values during their game play to estimate the player's condition. This testing reveals that there exists a correlation between the heart rate of the player and the game score.

III. METHODOLOGY

The key objective of the proposed work is to aid the mobile users decrease the amount of time they spend on gaming based on their heart condition. The comprehensive work has principally two sections one hardware section and another mobile game application.

A. HARDWARE SECTION

The hardware section constitutes of three components such as Arduino UNO, Pulse sensor, and Bluetooth module. The hardware section functions as a Heart Rate Monitoring System. The block diagram of the proposed hardware in Figure.3 describes how each component interacts with the microcontroller.

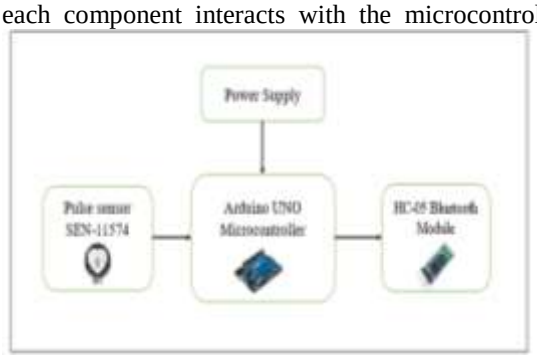


Fig.3. Block Diagram of Heart Rate Monitoring System

The Arduino Uno microcontroller which belongs to the ATMEGA family is used as the key processing unit of the proposed system. Pulse Sensor is a sophisticated heart-rate sensor that is used to monitor heartbeats and blood flow when a fingertip is placed on it. HC-05 Bluetooth Module is intended for wireless communication between the developed hardware and the mobile phone. The code for heart rate calculation is implemented in ARDUINO IDE. These components are connected as shown in figure.4 for the detection and transmission of HR values [10].

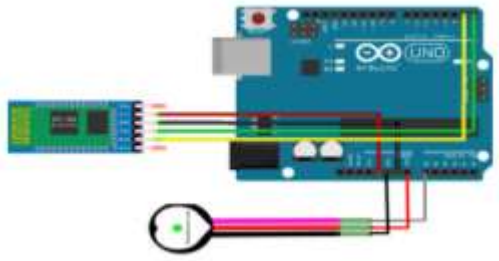
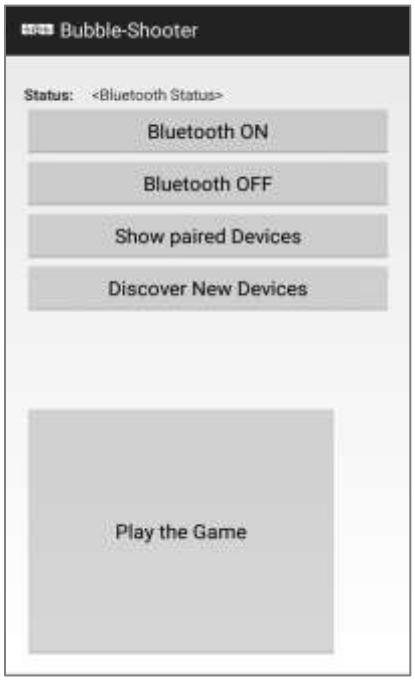


Fig.4. Circuit Diagram of Heart Rate Monitoring System

B. MOBILE GAME APPLICATION IMPLEMENTATION

A mobile gaming application has been developed to validate the concept of heart rate variability concerning mobile usage. For this purpose, a simple Bubble-Shooter gaming application for Android is designed using Eclipse software which is an integrated development environment (IDE) used in computer programming. This application consists of five levels with increasing difficulty from one level to another. When the player starts the application, the app constantly receives data from the hardware part, calculates the elapsed time, and determines the heart condition. Based on the heart rate values and screen time of the gaming app, a decision is made whether to allow the user to play or not.



(a)

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(b)

(c)

Fig.5. Gaming Application Layout (a) Home Screen (b) Game Levels Screen (c) Bubble-Shooter Game Level-3 Screen

C. WORKING

This Heart Rate Monitoring system uses a pulse sensor for data procurement. When the user places his/her finger on the Pulse sensor, it generates electrical signals from the incoming PPG signal [17]. These captured electric signals are processed by the Arduino UNO microcontroller to determine Inter-Beat Interval (IBI) in milliseconds and Heart Rate in bpm of the user. These processed HR values are transmitted to the mobile application for further processing. When the user starts the gaming application along with his/her finger placed on the sensor, then the application will start receiving the HR data via Bluetooth connection and calculates the elapsed time. If the HR is greater than 100bpm, the application regards it as an abnormal heart rate. A limit on screen time is predefined in the application. The application will generate an alert message followed by automatic termination of the game and will send a message regarding abnormality to the prescribed mobile number if the application records an abnormal heart rate along with exceeded screen time. In the absence of Bluetooth connection, the application uses only screen time as a decisive factor.

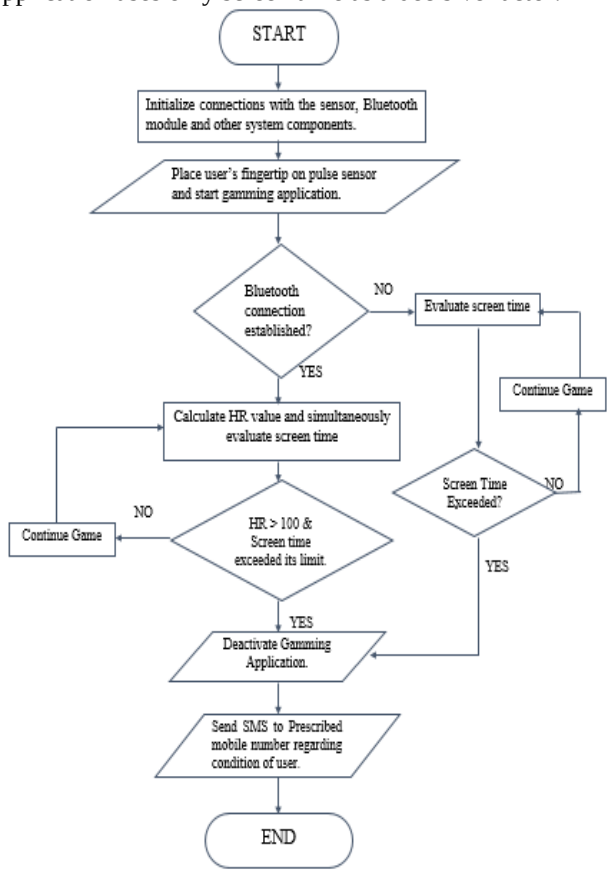

Fig.6. Flowchart

IV. RESULTS

The hardware part that was designed and implemented is shown in Figure.7 which is used for the collection, calculation, and transmission of heart

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rate readings of the user to the mobile application.

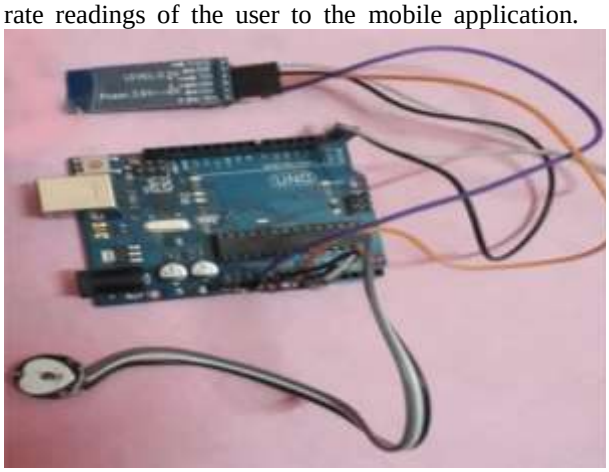
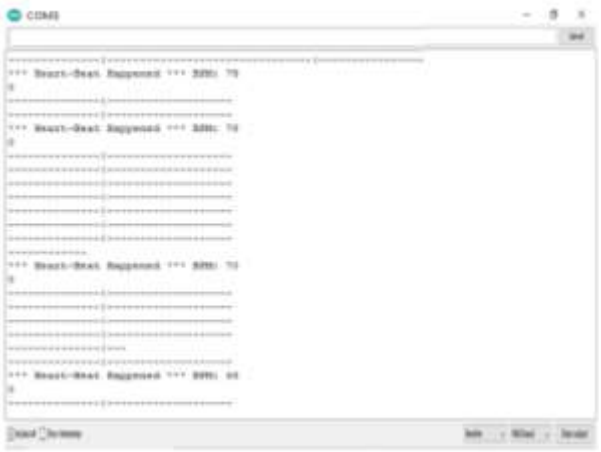


Fig.7. Hardware Implementation

The heart rates of diverse persons who are at resting position are recorded using the above-designed device. These readings are accurate enough when compared to the readings measured by existing Heart Rate monitors.



(a)

(b)

Fig.8. Recorded Readings (a) Normal Heart Rates (b) Abnormal Heart Rates

An alert message regarding abnormality displayed by the mobile application is shown in Figure.9 and the message sent to the mobile number prescribed in the application is shown in Figure.10. The prescribed mobile number in the application can be the player's parent's mobile number by which they come to know about their kid's heart abnormality and mobile usage.

Fig.9. Alert message displayed by the application

Fig.10. The message sent by the application to the prescribed mobile number

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V. CONCLUSION

In this paper, a mobile game controller with the help of a heart rate monitoring system was presented and implemented. The fundamental features of the proposed work are the calculation of HR from the data collected by the pulse sensor, the Screen Time evaluation of the application, the generation of an alert message followed by automatic closing of that game, and the transmission of the same alert message to the prescribed mobile number when an abnormal heart rate is detected accompanied by the transcended screen time. The designed hardware was able to calculate the heart rate of the user and transfer the processed data via Bluetooth to the developed mobile game application efficiently and the acquired HR readings are accurate enough when compared to the readings measured by existing Heart Rate monitors. The key shortcoming is that the user has to wear the device while playing the game.

In future work, this algorithm can be applied to any other social networking applications as well. The processed HR data can be subjected to further analysis and visualization applying the machine learning algorithms.

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