JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p.2204-2210
https://publishoa.com
ISSN: 1309-3452

AI Voice Coach and Emergency Modules for Smartwatch Framework

Dr.S.Muthukumar
Professor & Head., Department of Electronics and Communication Engineering
Sri Venkateswara College of Engineering
Chennai, India
muthukumar@svce.ac.in
Seshadri. N
B.E., Final year, Department of Electronics and Communication Engineering
Sri Venkateswara College of Engineering
Chennai, India
n.seshu8@gmail.com
Yashwanth. B
B.E., Final year, Department of Electronics and Communication Engineering
Sri Venkateswara College of Engineering
Chennai, India
yashwanthbala.cr7@gmail.com
Srivanth Ganesh
B.E., Final year, Department of Electronics and Communication Engineering
Sri Venkateswara College of Engineering
Chennai, India
srivanth2341@gmail.com

Received 2022 April 02**; Revised** 2022 May 20**; Accepted** 2022 June 18

Abstract— The present global scenario is witnessing a tremendous growth, in developing more effective devices and strategies in promoting healthcare and fitness. Smart watches have come to occupy a significant place as health monitoring devices. Against this backdrop, the present paper goes into dwell two primary objectives namely., 1.To develop an AI voice coach module to function as a virtual tutor, and 2.To design and put in place an emergency module to address a situation where the individual gets into critical levels during workouts. The purpose of this module is to trigger a SOS to an emergency contact in such situations. Appropriate algorithms have been used to install both the modules. The efficacy of the modules were put to test and found to be effective. The real-time testing and authentication with empirical data had lent added credence to the findings. The inclusion of these applications in the smart watch technology would constitute landmark value additions.

Keywords—AI Voice coach(AIVC), Emergency Module(EM), IoT, sensor, Heart rate (HR), Android, LCD, Smart watch.

I. INTRODUCTION

It is a fait accompli that health, fitness and workouts are inextricably intertwined. In general, most of us do recognize the strong nexus between workouts and fitness. The present global scenario is witnessing a tremendous growth, in developing more effective devices and strategies in promoting healthcare and fitness. Smart watches have come to occupy a significant place as health monitoring devices. The emergence of the use of smart watch as a self-monitoring health apparatus is of very recent origin. However, the advancements in adding several health related features in smart watches have been quite stupendous. At

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present, the smart watches even at the basic level are designed to monitor and display fitness related parameters such as heart rate and step count besides other technical features like Wi-Fi and Bluetooth. It needs to be underscored that smart watches have to come to stay and occupy a significant place in the health monitoring realm. Against this backdrop it is in order to reason that, smart watches can be programmed to facilitate tutorship through AI Voice coach for workouts. In addition, the required caution to the individuals doing workouts when their heart rate touches abnormal limits can also be added.

II. REVIEW OF LITERATURE

In tune with the major objectives of the present pursuit, this section provides a very brief review of literature. Accordingly, section A. sketches the documented work relating to AI Voice coach and smart watch and B. brings out the studies relating to various facets of emergency module in fitness.

A. Studies relating to AI Voice coach

In recent times, the literature relating to AI Voice coach is growing at a steady pace. AI Voice coach has several applications. It's tenets are widely used in marketing where consumers are guided to make selection [5], medical field where instructions are flowed procedurally for different purposes[7], in aeronautics where broad guidance is provided in the form of a virtual expertise flight operator[6] and a watch and ward in sports and physical fitness field[4]. In sports events, the scientific application of AI technology enables almost precise monitoring of athletes' physical conditions right from the start to the finish of the game.[9]. The substitution of a human coach by a virtual coach engineered through AI has come to spread even in everyday workout exercises. A research study conducted to assess the effectiveness of this substitution has led to the finding that more than a human coach, a virtual coach exhibits a lot of perfection in imparting instructions and guidance during every stage of physical activity. The findings have been verified and confirmed through a small sample of primary data, where 23 individuals where subjected to the physical activity. [3].

B. Studies relating to Emergency Module

Using Internet of Things (IoT) technology, each ambulance will be equipped with GPS and GSM modem which in case of emergency will send its GPS coordinates to the cloud server, which will then mark the shortest distance from its present location to the hospital via the place from where the emergency call has been raised.[1]. From this initial stage, this procedure is now being applied to situations wherever threat to human life and property exists. Medical application is one prominent development. To track the patient's health, the system uses temperature sensors, heart rate sensors, saline level indicators, and accelerometers. A small controller connects to the LCD display and Wi-Fi controller to provide web workers with information about patient health (remote detection hub). If there is a sudden change in the patient's heart rate or temperature, an IOT alarm will be delivered to the patient. The system displays the patient's heart rate, temperature, saline level and acceleration in real time with time stamps via the Internet.[2]. Emergency alert induced by IoT technology is now being widely employed in predicting and managing natural disasters. The proposed system uses interconnected smart modules to enable centralized data acquisition using Internet Of Things (IOT) and Wireless Sensor Networks (WSN) sensing and communication technologies to coordinate disaster management at the national and local levels in collaboration with relevant agencies and raise disaster risk awareness in real time.[8]. A brief review of literature relating to AI Voice coach and emergency modules points to the fact that the basic propelling mechanism treats these procedures in isolation. Further, the literature pertaining to the application of

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ISSN: 1309-3452

wireless alert mechanism for day to day physical activity appears to be severely limited. Reckoning this gap, it is proposed in this work to establish connectivity of virtual coach and wireless emergency systems. The smart watch technology forges as the right platform for executing this integration. The propelled engineering applications for smart watch could perhaps be the first of its kind.

III. FACETS OF AI VOICE COACH

This section outlines in the first place, section A, the basics of AI Voice coach and its application. B, describes the designing of AI Voice coach for workouts. A detailed explanation of various stages involved in installing the module is also presented and C, details out the implementation and results of the module.

A. Basics and Applications

The advancement in science and technology has been so marveling that humans are being effectively substituted by machines. AI Voice coach is one among them. It is designed to present a set or sequence of voice messages reckoning the situation and context. AI Voice coach can discharge the duties of a tutor in academics; an instructor in laboratories in the field of science and medicine; a guide in travel and tourism and a coach in sports and fitness workouts. Precisely AI Voice coach is a virtual manifestation of an associate in the field concerned. The most important facet in AI Voice coach is text-to-speech. Therefore it involves content writing. The key considerations in content writing are the setting, situation, context and the listener for whom AI Voice coach is to be placed. The present work, perhaps first of its kind, constitutes in exploiting the AI Voice coach in workouts targeted at achieving physical fitness. While the procedures involved in installing this are broadly based on earlier documented works, in particular "apiaudio" library.

B. Designing AI Voice coach for workouts

The designing task is very significant as it conditions its efficacy and operative mechanism. The purpose of this application is to motivate the individuals and describe the salient benefits of doing workouts. In this exercise, the following scheme has been followed: Firstly, the selection of script or text is carried out. This is text which normally would be spoken and recorded by a voice. A script is basically "content writing". This is very crucial because it would reach the targeted group. Scripts have to be precise and quite easy to comprehend by the users. In this exercise, scripts have been designed to create a situation that is favorable for the individuals doing workouts. The Second stage constitutes in, the transformation of text-to-speech. It is an intermediary step in the transition towards high quality audio files. There are several methodologies for achieving this transformation. Of these, Python coding language has been widely used. Making use of this platform, this work achieved the translation of content to audio. The next stage calls for the selection of voice. One of the strengths of creating audio synthetically is its scalability. For selection of the appropriate voice, a search has been carried out. Since the doers of workouts will not come under a single group, the voice selected in order to ensure that it has a good appeal and greater acceptance. Keeping in view the fact that text-to-speech alone may not get the required attention of the individuals; it has been decided to add sound tracks to play short musical notes. This process, which constitutes the final stage, is acknowledged as "Mastering" in AI Voice coach models. This has been done in order to avoid the monotony caused by pre-existing text-to-speech modules. Mastering has another advantage of incorporating different musical notes, very gentle to intense, in tune with the situation. The finality of this process culminates in the creation the "required audio file".

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C. *Implementation and results*

AI Voice coach module is basically realized through an Android application. An Android application is a software running on the Android platform which is built for mobile devices. In this work, the pre-existing Android Studio Platform has been used as the base. The application development warrants the deployment of an appropriate coding language. In most of the earlier exercises, where, AI Voice coach was developed, Java coding language was found to be more effective. Hence the same coding language, Java, has been used for the development of the application. The generated multiple audio files are incorporated into the android application and would get stored in the application itself. In order to make AI Voice coach more user friendly and communicative, the workouts are classified into 3 types, namely., Easy workout – Simple exercise lasting for 10 minutes ; Medium workout – Moderate with 20 minutes duration and Hard workout – Tougher physical exercise for 30 minutes. Before the start of the workout, the individual has to undergo HR check. If the HR displayed in the smart watch and transferred to Android application, falls in the normal range the virtual coach will start the user to start the exercise. If the HR goes beyond the critical level of 120, the user will be instructed to defer the workout for now. After clearance in HR check, the individual can choose the type of workout. The selection of Easy workout and its sequence are furnished in the following figure 1.

Figure 1 : Selection of Easy workout and its sequence

- HR CHECK = NORMAL (HR 92) – *Start your exercise*
- *Select your type of workout*
- *Easy workout selected*
- *You have selected the easy workout! This is a piece of cake! Lets get it done!.*
- *Walk for a period of 10 minutes.*
- *After 10 minutes, (application will show the timer). Great job! The easy workout is done.*
- *You didn't break a sweat!. Impressive!.*

Note: The text in italics are extracts from the AI Voice coach module developed in the Android Application.

In a similar fashion, the audio files for other types will play. Every workout type along with the HR CHECK was tested and found to be working as intended and designed for. The run through of different voice segments for the different types of workouts had gone along the designated path. Thus, the AI Voice coach module that has been developed and experimented proves to be effective in substituting the presence of a coach.

IV. ANATOMY OF EMERGENCY MODULE

The ultimate goal in the development of this system is to send an alert message to an emergency contact in case of the individual getting into abnormal heartbeat levels while doing workouts. Using the hardware namely., NodeMCU, GSM Module – SIM 900A, LCD 16x2, MAX30100(HR Sensor) and employing Arduino Software, the emergency module has been framed. For the operation of this module, appropriate coding has been done to interface hardware to the NodeMCU. This process will make the components to function in unison.

A. *Working mechanism of Emergency Module*

The workflow of the emergency module is depicted through a schematic presentation in Figure 2. The proposed emergency module has the unique feature of functioning as an independent unit and also as a part of the entire system in association with AI Voice

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ISSN: 1309-3452

coach. HR value as depicted in the above box diagram can go to the modules directly, through smart watch or indirectly through a sensor. Irrespective of the fact, whether the HR value gets into the system directly or indirectly, the emergency system gets activated. When the HR value gets into the critical level, an alert message is sent to the emergency contact. The same is shown through the box shaded in red.

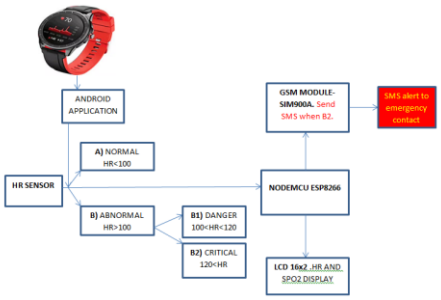

Figure 2: Workflow of EM

V. INTERFACING THE SMART WATCH WITH MODULES

Adopting an algorithm, the smart watch is interfaced with the android application. The development of algorithm lies in retrieving the HR from a file that gets stored in the Android mobile which is connected to the smart watch through Bluetooth. This would facilitate instantaneous functioning of AI Voice coach module once the HR value is transmitted from smart watch to the Android application. Almost on similar lines, the smart watch establishes connectivity with the emergency module through the application of Google Firebase. The emergency module's primary function is to send a text message to an emergency contact when HR during workouts crosses the value 120 (Critical level). This connectivity of all units will make the entire system comprehensive and renders testing in real time. An overview of the entire system is presented through a schematic diagram below:

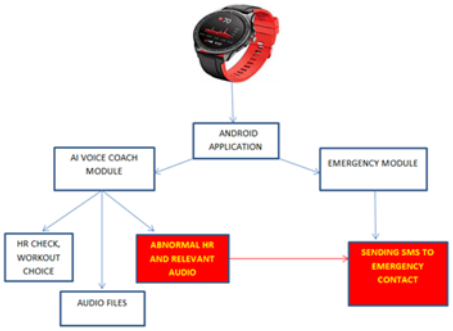

Figure 3: Overview of the Entire System

The designing of the modules and their presentation, facilitate multiple testing methods. The chief advantage of the entire exercise has been that each module has independent status as far as working and testing procedures are concerned. Apart from this, the whole system in its totality can also be verified for its output through established testing methods. One standard method among them is to assign random values at strategic points and check for the desired output. This is applied for AI Voice coach module. Second method runs in the form of a proxy testing for real-time testing. Here, the starter designed as a sensor will record (Figure 4) the values and pass it on to other modules. This is conducted for the emergency module.

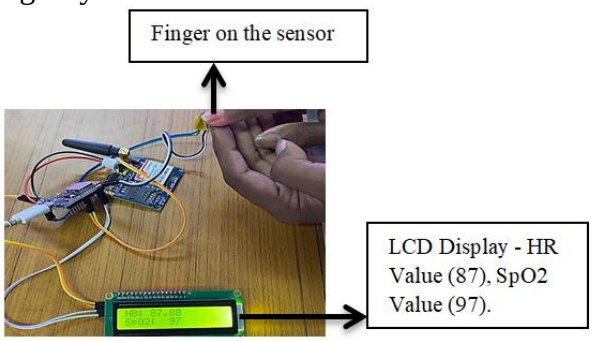

Figure 4: HR reading from sensor of EM
Source: Extract from Video recording of EM testing

The third method is real-time testing which will be applied for the entire interfaced system. Real-Time testing is considered as superior to these methods because indirect or proxy recording of HR value is done in the case of other methods. In real-time testing,

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ISSN: 1309-3452

the HR values are directly obtained from the smart watch, and passed on simultaneously to AI Voice coach and emergency modules to trigger them. It needs to be stressed that, the operation of these modules depend on the exact value of HR. As a part of real time testing, based on only the NodeMCU and GSM module, a few individuals were given the wearable smart watch and asked to walk/perform simple workouts in order to ensure HR value to fall at different ranges. It has been observed that:

i) Whenever HR value is less than 100, the AI Voice coach would advise the individual to continue to work out, and at the same time the emergency module would not give any signal.
ii) Whenever HR value falls in the range 100-120, the AI Voice coach would advise the individual slow down the workout as HR is in the danger level and at the same time the emergency module would not give any signal as in the first case and
iii) Whenever HR value gets to a value greater than 120, the AI Voice coach would advise the individual to stop the workout at once as HR is in the critical level and at the same time the emergency module gets activated to send an alert message to and emergency contact. The receipt of the same was confirmed.

The real time testing has established the performance of these modules initiated by HR in smart watch, had gone along the designed path.

VI. AUTHENTICATION OF OUTPUT THROUGH PRIMARY DATA

In order to enhance the credibility of the entire system, authentication of the output has been executed through a sample of primary data, as has been done in few studies[3]. A sample of 30 individuals were selected at random and subjected to different types of workouts at their will, individually, one after the other using the same smart watch and systems. The HR check disqualified 4 individuals as their HR values were abnormal. The other 26 were asked to choose the type of workout (Table 1).

Table 1: Selection of Workout

Type	Number of Persons
Easy (E)	10 (38.5%)
Medium (M)	12(46.1%)
Hard (H)	4(15.4%)
Total (T)	26(100%)

SOURCE: Primary data.

The individuals were asked to carry out the type of exercise with compliance to the speech of the voice coach. The duration for each workout will vary and also the contents, while the introductory and ending notes are motivational, workout specific and encouraging.

At the end of the workout, the individuals were asked few questions such as and their responses are taken note of for analysis.

How were the contents of the audio files? (Excellent/Good/Average/Poor).

Did you get impressed by the motivational content? (Yes/No).

Were the alert messages from both the modules sent on time? (Yes/No).

The table below (Table 2) presents the output of the two modules AI voice coach and emergency in accordance with the HR value for different individuals. For 17 individuals with HR value less than 100, the virtual coach advised them to continue workout while for 6 individuals who had HR value between 100 and 120, they could hear the virtual coach advising them to slow down workout. For the remaining 3, whose HR had gone beyond 120, in the critical level, the AI Voice coach instructed them to stop and emergency module triggered alert warning to their emergency contact. The receipt of the message from the emergency module has been verified with the recipient and the same stands confirmed by them. This primary data based validation of the entire system has added empirical research value to the entire exercise. The responses in general go to establish the fact that the

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modules with smart watch in central place had the potential to deliver its expected output.

Table 2: HR During Workout and Emergency alert

HR VALUE	E	M	H	T	Output :	
					AI VC	EM
90-95	3	2	-	5	Continue workout	-
95-100	2	9	1	12	Continue workout	-
100-120	5	-	1	6	Slow down workout	-
>120	-	1	2	3	Stop workout	**Message sent to emergency contact**
Total	10	12	4	26		

SOURCE: Primary data

VII. CONCLUSION

The installation and the working of the AI Voice coach and Emergency modules interfaced with smart watch makes the latter more relevant in workouts leading to fitness. The analysis of the results through primary data had led to uphold the efficacy of both modules as attested by the responses of nearly 90% of the sample. A large majority had responded quite well and positively about the working and output of the entire process from HR check on the smart watch to sending an alert message to the self through voice coach and to the emergency contact through the emergency module. This endeavor makes a good contribution to the smart watch technology and thereby making it a comprehensive device for fitness related exercises.

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