Exercise Monitoring System For Knee Osteoarthritis Patients

[1]Dr. Arockia Abins, [2]Hariharan C, [3]David Edward S, [4]Amith Kanuri

[1]Assistant Professor Department of Computer Science Engineering, Easwari Engineering College Chennai Tamil Nadu

[234]Department of Computer Science Engineering, Easwari Engineering College Chennai Tamil Nadu

Email: [1]arockiaabins.a@eec.srmrmp.edu.in, [2]iamhariharan2002@gmail.com, [3]davidedward2001@gmail.com, [4]amithkanuri07@gmail.com

Abstract— The present system does not have automatic exercise monitoring. Without assistance, the sufferer performs poorly. We created an innovative device known as an activity monitoring system specifically for individuals with knee osteoarthritis to address this issue. The safest way to relieve pain is through rehabilitation exercises. Individuals with knee OA frequently receive a prescribed exercise program at a medical institution using top-of-the-line, expensive rehabilitation equipment under the direction of a doctor. The therapeutic exercises can also be done at home. Yet, using the wrong method while a patient exercises at home might cause greater damage. This study recommends a rehabilitation exercise monitoring device for knee OA. Gyroscope sensors are used to get data from the shank concerning body movements. By employing the APR voice module as indicators, ARDUINO processes the gyroscope data for exercise classification and inaccuracy exercise movement identification.

Keywords—Cardiacvascular; Machine Learning; SPO_2

I. INTRODUCTION

The ability to transfer resources, the availability of qualified managers, proactive leadership, internal and external stakeholder involvement, solid alliances, and networking management have all been shown to have a substantial impact on university business incubator performance. No research has, however, examined how using modern technology, such as digital marketing, and upholding relevant Sustainable Development Goals (SDGs), can increase the contribution of university business incubators and entrepreneurial training programmes provided at HEIs to promote sustainable entrepreneurship. According to the current study, incubators and entrepreneurial training at HEI that are aligned with pertinent SDGs and the most recent technological innovations would be more relevant in developing future entrepreneurs capable of contributing to the sustainability agenda since everyone is focused on methodically pursuing SDGs to realise the 2030 agenda envisioned by the United Nations. To investigate the primary goals, technological advancements, and business unions in higher education. 38 firm owners, partners, or staff members who had recently worked with university business incubators or who had previously gone through entrepreneurship training at HEIs were questioned using open-ended essays. Content analysis of the qualitative data may be used to determine the degree of congruence between the SDGs 4, 9, 11, and 12 and the entrepreneurial training programmes and incubators currently offered at HEIs. Also, it showed how businesspeople

assessed how HEIs leveraged cutting-edge technological innovations, such digital marketing, to increase SDG awareness among important participants in the entrepreneurial ecosystem and make entrepreneurial education and firms more sustainability-focused.

II. RELATED WORK

[1] It has been demonstrated that blood pressure monitoring helps in the management of chronic medical disorders. However, automated home blood pressure monitoring devices only offer accurate readings when the user is at rest and cannot be utilize to continuously monitor blood pressure when exercising. Image-based analysis of skin color Changes were made in order to record the duration of the pulse In relation to blood pressure. In this study, we are assessing the viability of non-contact continuous blood pressure monitoring both at rest and during activity. It is necessary to employ a source of light outside the visible spectrum in order to use image-based volumetric optical histogram (iPPG) and image-based pulse transit time (iPTT) without being blinded by an intense visible light source. As a result, we added a high-speed camera that uses an infrared light source to measure iPPG and iPTT. Our initial research provided full support for the viability of this strategy, which was unclear at the study's beginning.

[2] The small geographic area of Saguenay-Lac-St-Jean in Quebec, Canada, has the highest prevalence of the rare disease myotonic dystrophy type 1 (DM1), which is also known as DM1. A person's quality of life and capacity for everyday tasks are both impacted by the illness. It may be advised that physiotherapists or other medical professionals provide suitable exercise regimens for patients to follow at home in order to lessen the effects of DM1. The cost and practicality of following every patient throughout their treatment plan, however, are prohibitive for specialists. Utilizing ambient technologies is an alternative. To do this, in this study, our team created a support system that can identify straightforward movement-related activities (AM) and keep track of each activity done when exercising. training exercises. The person can benefit from the system by having guidance and encouragement throughout the training process. Ten persons who have the condition were tested using the technique for ten weeks at their residences. The results are really positive, and we compare them to our prior laboratory work in order to discuss them. Finally, the datasets are publicly accessible to the public online to aid with pre-research.

[3] For athletes to meet certain fitness objectives, tracking physical activity is essential. A new method of tracking your fitness is with mobile radar. However, the Doppler effect brought on by movement in the sensor's field of vision is the only factor exploited in the current work, which makes it impracticable when there are numerous moving targets. This article will examine the viability of utilize FMCW radar to track training exercises where numerous moving targets are lighted by a single sensor. Noise cancellation was accomplished by utilize the range capacity of FMCW radar. The test findings show that, even in the face of significant interference, non-contact maneuver monitoring based on FMCW radars is still successful.

[4] In order to reach specified fitness objectives, athletes must keep track of their physical activities. A new technology for contactless fitness tracking is mobile radar. Current research, however, only takes into account the Doppler effect brought by movement in the sensor's field of vision, which is not practicable when there are

numerous moving targets. The viability of utilize FMCW radar to observe drills when several moving targets are lighted up by the same sensor will be examined in this study. Noise cancellation was accomplished by utilize the FMCW radar's range capacity. The test findings show that non-contact utilize monitoring based on FMCW radars is successful even in the face of significant interference.

[5] Dementia is a major issue for elderly people, and it's expected that number will increase significantly over the next few years. Despite the fact that there is no treatment for dementia, new research has indicated that exercise may benefit dementia patients' cognitive function. We suggest using a humanoid therapeutic robot to motivate people with dementia to exercise. A robot like this will aid in addressing issues like the expense of care and the lack of healthcare professionals. We have created an interactive robotic system and performed test runs with a robot that motivates users to do easy dancing steps. In order to choose which exercise move should be demonstrated, the heart rate is used as feedback. The outcomes we discovered are encouraging, and we intend to carry on this effort through additional research.

TABLE I.   COMPARISON OF LITERATURE SURVEY

Author	Methodology	Features
Chen K H	Image based analysis of skin color	viability of non-contact continuous blood pressure monitoring
Darwawan J, Isbagio H eds	identify straightforward movement-	having guidance and encouragement throughout
	related activities	the training process
Keefe, F.J., et al	Doppler Effect	FMCW radar to track training exercises where numerous moving targets are lighted by a single sensor.
O'Reilly, S.C., K.R. Muir, and M. Doherty	Doppler Effect	Noise cancellation was accomplished by utilize the FMCW radar's range capacity
Talbot, L.A., et al	Humanoid therapeutic Robot	choose which exercise move should be demonstrated, the heart rate is used as feedback

III. PROPOSED PLAN

An organisation known as a business incubator is one that offers developing businesses and start-ups concrete and intangible resources, such as office space, expertise, and other resources, in their early stages[15]. According to earlier research [19], [39], business incubators can be essential in nurturing and developing nascent firms. They have a track record of assisting newly established companies that usually lack finance by offering the required infrastructure assistance, network resources, and training to help these companies get through their growth pains[45]. In reality, the

strategic importance of business incubators has increased in contemporary innovation and entrepreneurial ecosystems [1], [15].

A. Exercise Monitoring

Gyroscope sensor is used to monitor the workout, LCD is used to display the current condition, and Arduino uno micro controller serves as the system's brain.
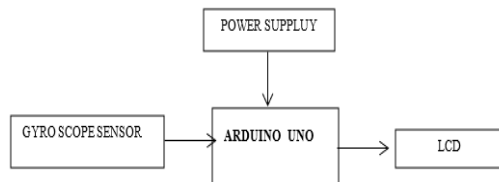

Fig. 1. Block Diagram for Exercise Monitoring

B. Data Transmitting

In this project we are using Arduino UNO micro controller, it acts as a brain of our system, ZigBee is used to transmit the data one controller to another controller, Zigbee TX will transmit the data, ZigBee Rx will receive the data.
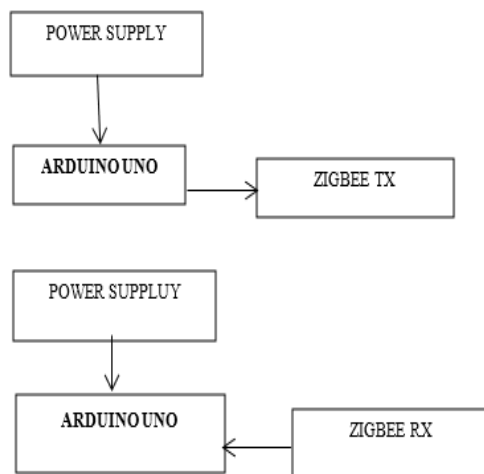

Fig. 2. Block Diagram for Data Transmitting

C. Exercise Changing

The Arduino Uno microcontroller serves as the system's brain in this setup, key pad is used to change the patient exercise, LCD is used to display the current status.
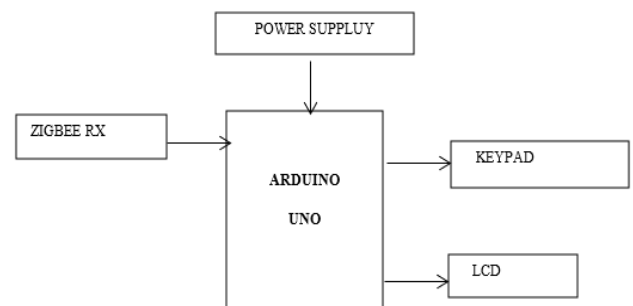

Fig. 3. Block Diagram for Exercise Changing
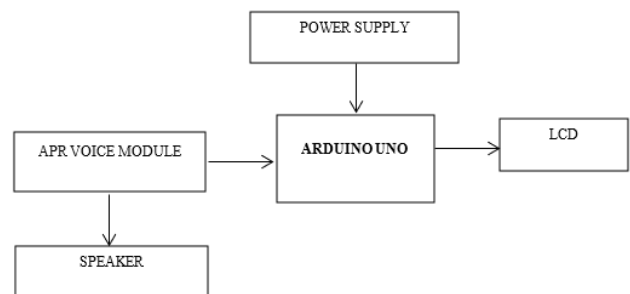
D. Intimation

Fig. 4. Block Diagram for Intimation

The Arduino Uno microcontroller serves as the system's brain in this setup, APR voice module is used for intimation purpose, if the patient does the exercise wrong it will alert the voice message, speaker will blow the sound, LCD is used to display the current status.
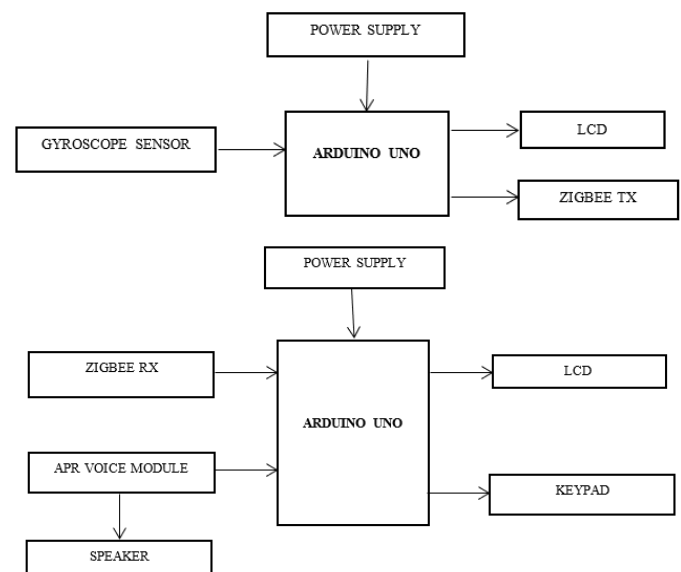

Fig. 5. Block Diagram for Proposed System

The ARDUINO UNO & ARDUINO NANO microcontrollers, which act as the

project's system's brain, store the whole system programme. The technique tracks the angle of the patient's workout using gyroscope sensors. We give some exercise for the input for the gyroscope sensor. ZIGBEE is used as a communication tool. If the patient doesn't do the exercise properly ZIGBEE transmit the data and give the alert to the master device. Keypad is used to give the number of exercises for the patients. And the APR voice module given the voice output for the patient whenever the exercise will go wrong. An LCD is used to show all the information.

IV. Hardware & Software Requirements

Hardware Requirements

A. Arduino UNO

Arduino was developed by the Ivrea Interaction Design Institute as a simple-to-use tool for fast prototyping geared for students with no prior knowledge of electronics or programming. The Arduino board changed from simple 8-bit boards to gadgets for Internet of Things (IoT) applications, wearable technology, 3D printing, and embedded settings as the number of users increased. Anybody is allowed to develop their own Arduino boards and then alter them to suit their own needs because every Arduino board is totally open-source. The program is growing as a result of donations from all across the world because it is open-source.

B. LCD

An LCD panel is a flexible type of electronic display. A 16x2 LCD display is a reasonably simple element that is commonly utilised in several devices and circuits. Compared to multi-segment LEDs with seven or more segments, these modules are preferred. LCDs' low cost, simplicity of

programming, and flexibility to show rare and even customised characters, animations, and other information without any restrictions are cited as arguments.

Two lines, each of which can display 16 characters, make up a 16x2 LCD. On this LCD, each character is shown using a 5x7 pixel matrix. The two registers on this LCD are the Command and Data registers.

C. Gyroscope Sensor

A device that measures and keeps track of an object's orientation and angular velocity is a gyroscope sensor. Compared to accelerometers, they are more recent. Although they can only detect linear motion, accelerometers can assess an object's tilt and lateral orientation.

The terms "angular rate sensor" and "angular velocity sensor" are also used to refer to gyroscope sensors. These sensors are put in situations where it is challenging for humans to discern an object's orientation.

The change in the object's rotational angle per unit of time, measured in degrees per second, is known as angular velocity. Gyroscope sensors make use of the Coriolis force hypothesis. By turning the sensor's rotational rate into an electrical output, this sensor can calculate the angular rate. You may realize the gyroscope sensor's working principle by realizing how the vibration gyroscope sensor functions.

This sensor contains a vibrating internal crystal element with a double-T shape made of crystallization material. The "Sensing Arm" and "Drive Arm" are affixed on each side of the permanent part in the middle of this construction.

To have a double-T structure is symmetrical. When the driving arms are exposed to an alternating vibration electrical field, continuous lateral vibrations are produced. All potential vibration leaks are stopped when one driving arm travels to the left and the other to the right because of the symmetry of the driving arms. This keeps the center stationary component and the stationary sensing arm stationary.

Software Requirements

D. Embedded C

The most popular programming language for creating electrical devices is embedded C. Every electrical gadget has a processor that is coupled to embedded software.

The effectiveness of the CPU in completing particular tasks is significantly influenced by embedded C programming. We utilise a variety of technological tools in our daily lives, including our mobile phones, washing machines, digital cameras, etc. This all-device functioning is based on microcontroller that are coded using embedded C.

E. Embedded System

It is a setup where every component works together to complete a task while adhering to a set of guidelines for real-time calculation. It may also be described as a method of carrying out one or more tasks in accordance with a predetermined schedule. An embedded system is one that has software integrated directly into the computer's physical components, making it especially well-suited for a certain use case, object, or component of a bigger system.

A huge combinational system or a tiny independent system can both be embedded systems. It is a control system that uses a microcontroller to do a certain task.

F. Microcontroller Strater Kit

A full microcontroller starting kit is necessary for creating projects based on embedded systems. This kit's main benefit over a simulator is that it operates in real-world conditions. As a result, it makes it simple to verify input and output functionality.

Consider what a starter kit for microcontrollers comprises of:

- Hardware Printed Circuit Board (PCB)
- In-System Programmer (ISP)
- Compiler, assembler, and linker are some embedded system tools.
- Sometimes an Integrated Development Environment is necessary (IDE).

G. Arduino UNO IDE

The Arduino Software (IDE), sometimes referred to as the Arduino Integrated Development Environment, is an alternative option. It contains a toolbar with buttons for frequently used functions, a message box, and a text terminal in addition to a text editor for scripting. It establishes a connection with the hardware in order to upload programmes and connect to it.

V. CONCLUSION AND FUTURE WORK

The sustainable development objectives are a global call to action to fight poverty, preserve the environment, and give everyone access to opportunity. The UN created the 17 Goals in 2015 as part of the 2030 Agenda for Sustainable Development, which also includes a 15-year implementation plan. Innovations in technology and entrepreneurship were seen as crucial tools for successfully accomplishing these objectives. Yet, it required the conscious labor and initiative of numerous actors to get the entrepreneurial ecosystem to a position

where it was fully in line with SDGs and was sustainability-focused. University business incubators are a crucial component of the contemporary entrepreneurial ecosystem because they provide young people with the entrepreneurial skills and assistance they need to launch and manage sustainability-focused firms. Future enhancement of this project we can monitor the patient with the help of AI, monitor through camera, if the patient does the wrong exercise automatically the it corrects the exercise and intimate the patient.

References

1. Chen, K.-H., et al., Wearable sensor-based rehabilitation exercise assessment for knee osteoarthritis. Sensors, 2015. 15(2): p. 4193-4211.

2. K., V., Epidemiology of Rheumatic Diseases in Malaysia. In Nasution AR, Darwawan J, Isbagio H eds. Proceedings of the 7th APLAR Congress of Rheumatology, 1992: p. pp 397-399.

3. Keefe, F.J., et al., Osteoarthritic knee pain: a behavioral analysis. Pain, 1987. 28(3): p. 309-321.

4. O'Reilly, S.C., K.R. Muir, and M. Doherty, Effectiveness of home exercise on pain and disability from osteoarthritis of the knee: a randomised controlled trial. Annals of the Rheumatic Diseases, 1999. 58(1): p. 15-19.

5. Talbot, L.A., et al., A Home-Based Pedometer-Driven Walking Program to Increase Physical Activity in Older Adults with Osteoarthritis of the Knee: A Preliminary Study. Journal of the American Geriatrics Society, 2003. 51(3): p. 387-392.

6. K. Aerts, P. Matthyssens, and K. Vandenbempt, "Critical role and screening practices of European business incubators," Technovation, vol. 27, no. 5, pp. 254–267, 2007.

7. H. Allahar and R. Sookram, "Emergence of university-centred entrepreneurial ecosystems in the Caribbean," Ind. Higher Educ., vol. 33, no. 4, pp. 246–259, 2019.

8. H. Allahar and R. Sookram, "A university business school as an entrepreneurial ecosystem hub," Technol. Innov. Manage. Rev., vol. 9, no. 11, pp. 15–25, 2019.

9. I. G. B. A. Budaya, G. I. R. Martha, D. P. Agustino, I. M. P. P. Wijaya, and I. G. Harsemadi, "Prediction model for the tenant's potential failure from business incubation process during COVID-19 period using supervised learning," in Proc. 3rd Int. Conf. Cybern. Intell. Syst., 2021, pp. 1–5

10. J. P. C. Cravo and J. P. C. Marques, "Development of innovation in companies in incubation: The case of Portugal," Int. J. Innov. Manage., vol. 23, no. 2, 2019, Art. no. 1950018.

11. S. Dahms and S. Kingkaew, "University business incubators: An institutional demand side perspective on value adding features," Entrepreneurial Bus. Econ. Rev., vol. 4, no. 3, pp. 41–56, 2016.

12. G. Dalmarco, W. Hulsink, and G. V. Blois, "Creating entrepreneurial universities in an emerging economy: Evidence from Brazil," Technological Forecasting Social Change, vol. 135, pp. 99–111, 2018.

13. M. Donegan, "Bridging commercialisation and redevelopment: Jurisdictions and university policy development," Urban Stud., vol. 56, no. 9, pp. 1768–1785, 2019.

14. M. Donegan and N. Lowe, "Going local: Placing entrepreneurial microgeographies in a larger regional

context," Ind. Innov., vol. 27, no. 8, pp. 871–891, 2020.

15. J. Goraֻczkowska, "Enterprise innovation in technology incubators and university business incubators in the context of Polish industry," Oeconomia Copernicana, vol. 11, no. 4, pp. 799–817, 2020.