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Diagnosis of Parkinson's: A Novel Approach

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Abstract: *In Europe, 1.2 million people suffer with Parkinson's disease (PD), and during the next few decades, there will likely be an exponential increase in the disease's prevalence. The lack of neurologists qualified to provide skilled care for Parkinson's disease (PD) will provide a challenge to this epidemiological trend. Patients are calling for strict symptom management and treatment education as Parkinson's disease (PD) becomes more widely recognized. Furthermore, due to the very diverse character of symptoms among patients as well as changes within the same patient, new tools are needed to enable clinicians and patients monitor the disease in the context of their daily lives and modify treatment in a more pertinent manner. Currently, a number of body-worn sensors (BWS) have been proposed to track clinical aspects of parkinsonian patients, including motor variations like tremor, has been included to tools for research and patient management. Here, we offer a useful anthology that highlights the features of the BWSs that PD patients in Europe use the most, with an emphasis on how they might be used as instruments to enhance therapy management. Technology for monitoring non-motor aspects is also taken into consideration. BWS undoubtedly present fresh chances to enhance PD management tactics, but it's important to define exactly how they fit into everyday routine treatment.*

Keywords: EMG sensor, OLED, MPU-9250, XCLUMA vibration module

I. INTRODUCTION

Parkinson's disease (PD) is a condition that affects the brain and leads to problems with movement. It's important to detect and monitor PD early to manage it well. Traditional methods to predict PD mostly use data from movement sensors worn on the body, which can limit how well these predictions work. We have a new idea for a healthcare system that predicts PD by combining different types of data. Instead of just using movement data, our system also includes voice recordings. This combination makes the predictions more accurate and thorough. The proposed system combines wearable sensors for capturing movement data with microphones for recording voice samples. Real-time analysis of multi-modal data streams enables continuous monitoring and early detection of PD symptoms. Our embedded system provides an integrated approach to Parkinson's disease (PD) prediction through the use of movement and voice data. This allows for the timely intervention and improved outcomes for patients. With potential applications in addition to PD prediction in various healthcare domains, it offers an innovative structure for utilizing multimodal data in healthcare systems.Individual treatment is important because each person's symptoms are different and change over time. Physical therapy is often used to help with balance and movement. Sometimes, surgery like deep brain stimulation is used to treat symptoms. There is no cure for Parkinson's disease. It's important to detect and monitor PD early to manage it well. Traditional methods to predict PD mostly use data from movement sensors worn on the body, which can limit how well these predictions work. We have a new idea for a healthcare system that predicts PD by combining different types of data. Instead of just using movement data, our system also includes voice recordings. This combination makes the predictions more accurate and thorough. The proposed system combines wearable sensors for capturing movement data with microphones for recording voice samples. Real-time analysis of multi-modal data streams enables continuous monitoring and early detection of PD symptoms.

II. LITERATURE SURVEY

Researchers have been interested in the domain of developing advanced system for detection of PD since a decade.

Ali, L et al.,[1] The study introduces MMDD-Ensemble, a method for detecting Parkinson’s disease (PD) using voice data from smartphones (SP) and Acoustic Cardioid (AC) channels. It explores four types of data from each channel. The study develops base classifiers and combines their predictions using blending and voting techniques. MMDD-Ensemble outperforms other models, offering better accuracy in detecting PD through voice analysis.

Jenna E. Throp et al., [2] The literature review explores wearable sensor systems for monitoring Parkinson's disease motor symptoms during daily activities. Current technology is found to be efficient yet often hard, requiring a number of sensors. Machine learning, especially neural networks, shows promise with fewer sensors, yet further validation in natural settings is needed for practical use.

Bounsall et al.,[3] This review looks at how AI is used to assess, monitor, and manage symptoms of Parkinson's disease (PD). It searches five databases for studies that use machine learning and deep learning to help with PD. The review will compare different AI methods and find challenges in PD care. It is expected to be finished by September 2023.

Monje. M. H. G. et al., [4] New sensor-based and wearable technologies show promise in transforming how Parkinson’s disease (PD) is diagnosed and monitored by providing objective measurements of motor symptoms. However, their use is limited due to a lack of validation and standards. To successfully complement traditional tools in the future, it is necessary to identify current issues, develop solutions, and test their feasibility in various populations.

V. Skaramagkas et al., [5] This review looks at how advanced deep learning techniques can diagnose Parkinson's disease (PD) by analysing different types of data, such as how people walk, move their arms, speak, and show facial expressions. It finds that these techniques are promising for diagnosing PD and assessing its severity. However, there are challenges with getting enough data and understanding how the models work. More research is needed to improve their use in real-life medical settings.

S. Pardoel et al., [6] This review studies how wearable sensors are used to detect and predict when people with Parkinson's disease might have freezing of gait (FOG). It looked at 74 studies and found that while advanced computer techniques are helping, there are problems like not having enough data and each person's FOG being different. Some methods, like transfer learning and semi-supervised learning, show promise. The review suggests more research to make these methods better for predicting FOG in Parkinson's disease.

A. Papadopoulos et al., [7] Researchers have created a smart way using deep learning on smartphone data to find Parkinson’s disease (PD) and its movement problems very accurately. This helps find PD early and start treatment quickly. Sometimes, it might say someone has PD when they don't, so more research is needed to fix this issue.

PD. V. Tsakanikas et al., [8] The study looked at how Parkinson's disease patients walk using special insoles and IMU sensors. Both systems accurately measured walking patterns and identified problems, showing strong agreement between their measurements. Machine learning also accurately classified these patterns. IMU sensors were easy for patients to use at home. However, more testing is needed in everyday walking situations to confirm these findings.

III. METHODOLOGY

The methodology involves gathering detailed data using IMU sensors to capture movement details, EMG sensors for muscle activity analysis, and microphones for recording speech patterns. This data is processed in real-time by the ESP32 microcontroller, which uses its built-in algorithms. The results are displayed on an OLED screen and users receive tactile feedback through vibration motors. This system combines sensors (IMU for movement, EMG for muscle activity, and a microphone for speech patterns) to gather detailed data related to Parkinson's disease. The ESP32 microcontroller processes this data swiftly using specialized algorithms. The processed information is displayed on a small screen for the user to monitor, while tactile feedback via vibrations alerts them to significant changes. Fig 1 illustrates block diagram of the proposed work. This real-time monitoring capability enables early detection of Parkinson's symptoms, facilitating prompt medical intervention for better management of the disease.

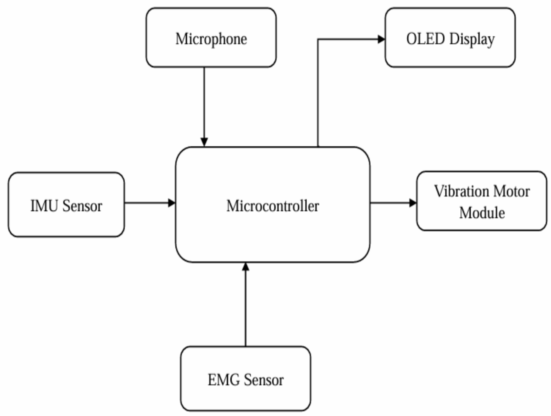

Figure 1: Block Diagram

Based on literature research and the authors' professional judgment, the performance, validation procedure, usability, and clarity of the reports for each BWS strength and weakness have been compiled. "The application of low power wearable wristbands to control a robot's movement with static hand motions. The wristband recognizes and categorizes arm motions Although the robot can be controlled intuitively by the user, the system's posture recognition rate could be enhanced. The wristband's possible use for regulating the movements of other devices, such autonomous cars and wheelchairs, is also mentioned in the article.

Motion Capture Systems: Motion capture systems are advanced setups used to record and analyse human movement. These systems generally involve Sensors. Some systems use inertial sensors, such as accelerometers and gyroscopes, embedded in wearable devices to track motion without requiring a camera-based setup. Laboratory-based motion capture systems provide highly accurate data on joint angles, gait patterns, and overall kinematics.

Wearable Sensors: Wearable sensors are devices worn on the body that collect data about movement and physiological parameters. For Parkinson's disease detection, these may include:

Accelerometers: Measure acceleration forces in multiple directions. Useful for detecting tremors and general movement patterns.

Gyroscopes: Measure rotational movement, helping to analyse postural stability and gait abnormalities.

Magnetometers: Detect orientation and can help assess balance and spatial orientation.

Application in Parkinson's Disease: Parkinson's disease is characterized by motor symptoms such as tremors, rigidity, bradykinesia (slowness of movement), and postural instability. Motion capture systems and wearable sensors help to detect the symptoms.

Data Analysis: Quantify Motor Symptoms: Data on movement patterns, speed, and frequency of tremors are analysed to assess the severity of symptoms.

Strength and Weakness:The system keeps track of Parkinson's symptoms all the time, allowing quick action if symptoms get worse. This helps doctors change treatments quickly if needed. It uses information from how you move, your muscle activity, and your voice to give a complete picture of your symptoms. This way, it catches more details about the disease than if it only looked at one type of data. The OLED screen and vibration motor give instant feedback to the user, making the device easy to use and understand. This real-time feedback helps users know what's happening with their condition right away. With Wi-Fi, doctors can monitor the data remotely and keep records. This means doctors can check on the patient's condition from anywhere, reducing the need for frequent visits to the clinic.

IV. SENSOR SELECTION

MPU-9250: The MPU-9250 is a highly regarded Inertial Measurement Unit (IMU) module that integrates a 3-axis gyroscope, a 3-axis accelerometer, and a 3-axis magnetometer into a single chip. Renowned for its precision and reliability, the MPU-9250 is well suited for applications requiring accurate motion sensing and orientation tracking.

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ESP 32: The ESP32 is a versatile microcontroller known for its powerful performance, built-in Wi-Fi and Bluetooth capabilities, and low power consumption. It is widely in IoT (Internet of Things) projects and offers ample resources for implementing complex functionalities.

Vibartion Motor Module: The Vibration Motor Module is a compact, easy-to-use module that integrates a small DC vibration motor, typically used for haptic feedback in various applications such as mobile devices, wearable electronics, and handheld gadgets. The module is designed to simplify the process of adding vibration alerts or feedback to your project, featuring a built-in transistor driver circuit that allows it to be easily controlled by a microcontroller, such as an ESP32. The vibration motor module offers haptic feedback, providing tactile notifications and alerts to the user. This feature is particularly useful in situations where visual or audio feedback might not be effective, ensuring that important alerts are felt by the user.

OLED:OLED, or Organic Light-Emitting Diode, is a display technology that utilizes organic compounds to emit light when an electric current is passed through them. Unlike traditional LCD (Liquid Crystal Display) screens that require a backlight, OLED displays generate their own light, allowing for thinner, more energy-efficient, and flexible screen designs.

EMG Sensor Module with Cable and Electrodes:

The EMG Sensor Module is crafted to accurately detect muscle signals, making it a valuable tool for detailed muscle activity analysis. The included cables and electrodes ensure easy and efficient signal acquisition, offering a complete setup for immediate use. This kit is perfect for those looking to incorporate EMG technology into their projects, whether for educational, research, or personal interest purposes.

By integrating these components, the proposed system aims to offer a comprehensive solution for monitoring and analyzing human activities, with applications ranging from healthcare and rehabilitation to sports and fitness tracking. The use of advanced algorithms for data processing and real-time feedback mechanisms enhances the system's accuracy and usability, making it a valuable tool for various user needs.

V. RESULTS AND DISCUSSION

The developed system collects different types of data using sensors and microphones built into our systems. Inertial Measurement Unit (IMU) measured how people moved, including shaking and walking problems linked to Parkinson's Disease (PD). Microphone records how people spoke, noting changes in voice caused by PD.The ESP32 microcontroller handled these data streams right away, using special math to find important details and study them. We made models that use data from our sensors to guess when or how Parkinson's disease (PD) might start or get worse. These models look at lots of information to make their guesses more accurate. Our system can tell people right away if it notices something wrong, using screens to show messages and pictures. This helps people know when they might need to see a doctor or change their treatment.

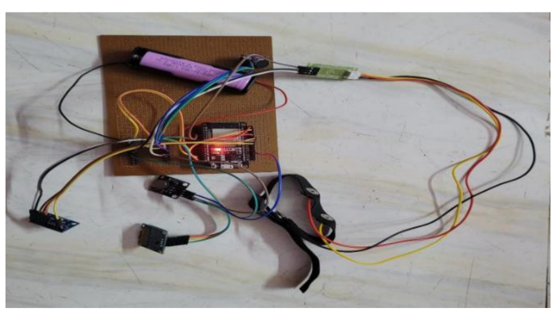

Figure 2: Prototype

a) Result of Normal Person:

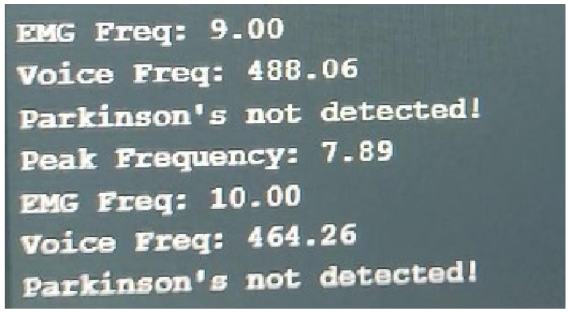

Figure 3: Picture of normal person's outcome

The Figure 3 shows the tested result of normal person.

b) Result of Patient:

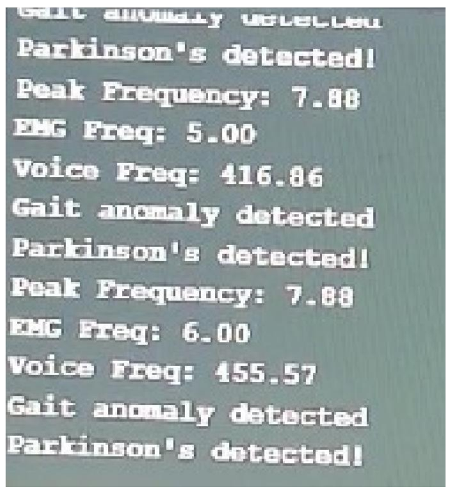

Figure 4: Picture of the patient's outcome

The Figure 4 shows the tested result of patient.

VI. FUTURE SCOPE &CONCLUSION

Looking forward, future enhancements could focus on enhanced data analytics. This involves using smart computer programs to better understand the data collected and make more accurate predictions about what might happen next. By improving the accuracy of data interpretation, healthcare providers can make more informed decisions regarding patient care. Implementing advanced machine learning algorithms could detect Parkinson's disease more accurately and at earlier stages. Early detection is crucial for improving diagnosis and treatment outcomes, as it allows for timely intervention and potentially slows the progression of the disease. Cloud integration could leverage big online storage and computing resources to handle large volumes of data simultaneously. This would enable more comprehensive data analysis and facilitate real-time monitoring and management of Parkinson's symptoms on a larger scale. Longitudinal studies could monitor individuals with Parkinson's disease over extended periods, providing valuable insights into how the condition evolves over time. This long-term data collection is essential for understanding disease progression and developing more effective treatment strategies. Interdisciplinary collaboration could involve working with doctors, scientists, and experts from various fields to enhance the system's effectiveness. By integrating diverse expertise, the system can be continually improved to better assist individuals with Parkinson's disease. By translating user gestures into movement commands, the sensor band makes intuitive control possible. The addition of health monitoring gives consumers who are concerned about their health an extra layer of security. The development process includes system design, software development, hardware integration, and extensive testing. Extra care is taken to ensure user safety,

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optimize the vibration detecting technology, and create an easy-to-use interface. This research marks a major leap in assistive technology and intends to improve the quality of life, mobility, and independence of people with Parkinson illnesses. An instance of how technology can be employed to address specific requirements in the field of mobility assistance is the sensor band system, which combines health monitoring and body tremor control.

REFERENCES

[1] Ali, L., He, Z., Cao, W., Rauf, H. T., Imrana, Y., & Heyat, B. B. (2021). MMDD-Ensemble: A multimodal Data–Driven Ensembleapproachforhttps://doi.org/10.3389/fnins.2021.754058 Parkinson's disease detection. Frontiers in Neuroscience, 15.

[2] Jenna E. Throp, Peter Gabriel Adamczyk, Heidi-Lynn Ploeg and Kristen A. Pickett "Monitoring motor symptoms during activities of daily living in individuals with Parkinson's disease,"journal-article,Dec.2018.doi: 10.3389/fneur.2018.01036.

[3] Bounsall, K., Milne-Ives, M., Hall, A., Carroll, C., & Meinert, E. (2023). Artificial Intelligence Applications for assessment, monitoring, and Management of Parkinson Disease Symptoms: Protocol for a Systematic review. JMIR Research Protocols, 12, e46581. https://doi.org/10.2196/46581

[4] Monje, M. H. G., Foffani, G., Obeso, J., & Sánchez-Ferro, Á. (2019). New sensor and wearable technologies to aid in the diagnosis and treatment monitoring of Parkinson's disease. Annual Review of Biomedical Engineering, 111–143. https://doi.org/10.1146/annurev-bioeng-062117-121036

[5] V. Skaramagkas, A. Pentari, Z. Kefalopoulou, and M. Tsiknakis, "Multi-Modal Deep Learning Diagnosis of Parkinson's Disease—A Systematic Review," journal-article, May 2023. doi: 10.1109/TNSRE.2023.3277749.

[6] S. Pardoel et al., "Wearable-Sensor-Based Detection and Prediction of freezing of GAIT in Parkinson's Disease: a review," Sensors, vol. 19, pp. 5141–5141, Nov. 2019, doi: 10.3390/s19235141.

[7] A. Papadopoulos et al., "Unobtrusive detection of Parkinson's disease from multi-modal and in-the-wild sensor data using deep learning techniques," Scientific Reports, vol. 10, no. 1, Dec. 2020, doi: 10.1038/s41598-020-78418-8.

[8] V. Tsakanikas et al., "Evaluating Gait Impairment in Parkinson's Disease from Instrumented Insole and IMU Sensor Data," Sensors, vol. 23, no. 8, p. 3902, Apr. 2023, doi: 10.3390/s23083902