सह विर्य करवावहे

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Abstracts

Track-4

Medical Devices & Digital Health

Theme Coordinator

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AIC-2025-MD-011

Design of IoT Enabled Sickle Cell Screening System Using Off-the-shelf Sickle Cell Solubility Test Kit

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Sickle Cell Disease (SCD) is a genetic blood disorder in sub-Saharan Africa and India that necessitates early diagnosis for effective management. The Screening available are electrophoresis and high-performance liquid chromatography (HPLC). They are reliable but costly, requiring laboratory infrastructure. In contrast, off-the-shelf Sickle Cell Solubility Test Kits, like AccuSure/Cruise/Biolabs, offer a low-cost, rapid, and straightforward diagnostic method based on sickle haemoglobin (HbS)'s differential solubility in reducing agents. This paper proposes an integrated system combining the off-the-shelf solubility assay kit with IoT-enabled hardware and software components for automated screening. The design improves the shortcomings of traditional manual testing, giving scope to digital interpretation and real-time reporting, increasing screening reach in resource-limited settings.

Keywords: IoT, Sickle Cell Screening

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SEMG of the Pelvic Floor Muscles as A Diagnostic Tool to Assess the Pelvic Floor Muscle Dysfunction – Using Pheezee

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80% of women at least once in their lifetime experience pelvic floor dysfunction (PFD). The most commonly used technique to assess pelvic floor muscle (PFM) is manual muscle testing/penetration methods, which are highly inconvenient for the patient. Therefore, many women often ignore getting treated in the initial stages, leading to worsening of the condition. Pheezee, an innovative and wearable surface Electromyography (SEMG) measuring device, helps measure pelvic floor muscle activity during contraction and relaxation. This non-invasive technique helps diagnose the PFM condition, assists in treatment decisions, and combined with the relevant clinical information can be a useful diagnostic tool.

Keywords: SEMG, Pelvic floor muscle, Pelvic floor disorders

SEMG of the Pelvic Floor Muscles as A Diagnostic Tool to Assess the Pelvic Floor Muscle Dysfunction – Using Pheezee

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Abstract: 80 % of women at least once in their lifetime experience pelvic floor dysfunction (PFD) [1]. The most commonly used technique to assess pelvic floor muscle (PFM) is manual muscle testing/penetration methods, which are highly inconvenient for the patient. Therefore, many women often ignore getting treated in the initial stages, leading to worsening of the condition. Pheezee, an innovative and wearable surface Electromyography (SEMG) measuring device, helps measure pelvic floor muscle activity during contraction and relaxation. This non-invasive technique helps diagnose the PFM condition, assists in treatment decisions, and combined with the relevant clinical information can be a useful diagnostic tool.
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1. Introduction

The PFM, with the associated connective tissue, helps stabilize the lumbar spine, hips, and pelvis. The primary function of the PFM includes the storage and evacuation of the urine, faecal material, and maintaining sexual health. Any dysfunction in the neuromuscular components of the PFM system caused by hormonal changes, natural aging process, lifestyle changes, and pregnancy can lead to various pelvic floor disorders like urine incontinence (UI), faecal incontinence (FI), and Pelvic organ prolapse (POP). Lack of awareness and no proper early intervention cause worsening of the issues and reduced quality of life in women. Proper awareness will help in timely and early intervention, leading to proper care.

When a woman visits a gynaecologist for any PFD, the first intervention is manually checking the pelvic floor by palpating the vagina or by finger insertion to understand the strength and anatomy of the pelvic floor muscles. Undergoing this process multiple times on each visit will cause a high psychological burden on the patient and might affect the willingness to seek early intervention. Even though there are technologies like pressure sensors, electromyography (EMG), MRI, and X-ray to assess PFM noninvasively, they are either not readily available, expensive, or uncomfortable to undergo. Diagnostic methods that are mainly used are manual inspections and MRI scans. SEMG of the PFM is a reliable non-invasive technique for measuring the electrical activity of the PFM during strength, endurance, and relaxation. Even though SEMG is widely used in research and as a biofeedback tool to assess and train the PFM, it is not as widely used during clinical assessment and diagnosis. In the current research, we focus on using the SEMG techniques in clinical settings, especially correlating with the patient's clinical conditions, to understand and diagnose the PFD.

2. Methods & Material

1.1. Material

Pheezee, an innovative wearable device, is highly feasible and acceptable, measuring the SEMG and range of motion (ROM) from muscles and joints [2]. It consists of two modules (upper and lower) operating on a low-power battery, wirelessly connected with an Android-based mobile application and cloud storage, as shown in *Fig*. 1D. Comparing with the gold standard measuring devices for SEMG and ROM, Pheezee measures ROM with 98% accuracy and SEMG with 96% accuracy [3]. Electrode cable accommodates three Ag/AgCl (Silver/Silver Chloride) electrodes with one reference and two differential electrodes to measure the activity of the superficial muscles. The acquired raw EMG signals are processed on the hardware and through digital filters to remove unwanted noise. Parallel to the SEMG data, patient information such as demographics, clinical conditions, and surgical history is collected through the Android application and stored on the cloud for further analysis.

1.2. Method

To acquire the SEMG of the PFM with Pheezee, the participants were first instructed to lie down in a crook lying position with their hands resting on either side, relax, and breathe normally, as shown in *Fig*. 2A. The patient is briefed about the testing procedure to ensure they are comfortable taking the test, and a consent form is signed. A physiotherapist responsible for the test prepares the skin for the surface electrode placement. The measuring electrodes were secured at the prescribed position (Levator Ani muscle), and the reference electrode was placed at the inner thigh, as shown in *Fig*. 2C. All SEMG assessments were performed in this position.

Baseline assessment of PFM SEMG was acquired by relaxing. In contrast, strength assessment was performed by instructing the participants to contract and relax muscles for 10 seconds at their self-selected comfortable speed. The endurance measurement was performed for 10 seconds, where the patient squeezed and held the pelvic floor muscle for maximum hold time. Apart from the SEMG data, demographics, and other questionnaires regarding the patient's clinical condition, such as menopause age and surgical history, is collected in the Pheezee app. In case of pregnancy, the stage of pregnancy, number of deliveries, whether they underwent C-section or normal, etc., are collected.

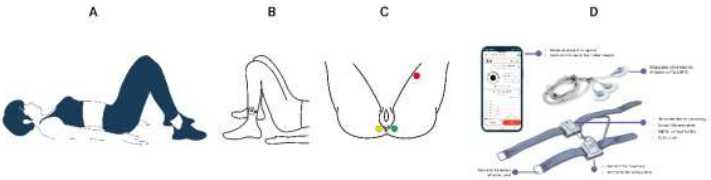

Fig. 1: Figure depicting A. the crook lying position, B. Pheezee device placement, C. SEMG Electrode placement, and D. the components of the Pheezee device

3. Conclusion

Using Pheezee, the SEMG of the PFM is measured noninvasively and is correlated with the patients' conditions through cloud-based data storage and analysis. This technique can help replace the insertion probe diagnosis for pelvic floor-related dysfunction and could help in differential diagnosis for sexual dysfunctions and clinical conditions like Dyspareunia and Vaginismus. This non-invasive technique benefits adolescents, where insertion techniques are not used. SEMG using Pheezee can be performed by any trained technician without requiring certified clinicians. Being affordable and non-invasive, Pheezee helps people seek early treatment. It would be more convenient to take multiple trips to the gynaecologists as and when needed, and it can even be used in a home-based setting. The biofeedback feature on Pheezee helps understand the PFM state and its progress over time, primarily through audio and video feedback. This is majorly helpful as the PFM is not an easily accessible muscle. Correlation of the patient's clinical condition with the SEMG helps the physician/Gynaecologist take appropriate treatment measures. Therefore, using Pheezee in clinical settings to diagnose PFDs and decide on appropriate treatment protocols can be a crucial technology reform. Pheezee is an example of how making affordable technology convenient and accessible to clinicians and the general public can help improve rehabilitation, treatment planning, and quality of life.

4. References

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CERTIFICATE
OF PARTICIPATION

This is to certify that

(Dr/Mr/Ms)

Suresh Susurla

has successfully presented his/her paper titled

"SEMG of the Pelvic Floor Muscles as A Diagnostic Tool to Assess the Pelvic Floor Muscle Dysfunction - Using Pheezee"

during the 68th Annual IETE Convention on

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Yours sincerely,

(Dr Umesh Kumar Tiwari)
Organizing Chair, AIC-2025