

Implementation of Sensor Technology in Smart Denture Design: A Targeted Response to Occlusal Trauma and Monitoring Deficiencies Among Rural Denture Users in Nigeria

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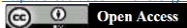
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ABSTRACT

Nigerian rural communities experience premature removable denture loss since dental practitioners fail to identify occlusal trauma post-denture delivery which allows stress-induced teeth bruxism to develop and coincides with inadequate follow-up dental care. This document explains a digitally validated smart denture system which resolves the addressed problem. The standard acrylic denture base contains 12-point quantitative pressure sensors together with a cortisol biosensor. Through Bluetooth Low Energy (BLE) the system transmits dental pressure data and stress information to mobile storage where they securely reside in blockchain databases for remote analysis. A machine learning model performs an occlusion anomaly classification of unilateral posture overload and bruxism during simulated cycles with an accuracy of more than 96%. The detection of cortisol enables monitoring of stress-driven bite patterns that show direct correlation to simulated bruxism manifestations. Such an intelligent denture solution offers a scalable method to monitor post-insertion dental patients in areas without access to clinical services through elimination of direct patient assessments. Early trauma assessment combined with trauma reduction and digital workflows between providers and patients receives support from this technology.

Introduction

1.1 Background and Public Health Burden

Nigeria encounters a worsening oral health situation among senior citizens who also belong to underprivileged groups with minimal availability of rehabilitative dental services. The entire population who requires complete or partial dentures exceeds 14 million in the country yet most of these patients live in peri-urban and rural regions which have limited oral healthcare resources. Government-run dental outreach programs and mobile prosthetic services deliver single-use prosthesis devices to patients who lack assessments along with iterative monitoring [2]. The majority of dentures show detrimental occlusal misalignment as well as progressive trauma-caused fractures in the first period of six months following prosthetic placement. The most typical complications associated with denture use consist of eating-related pain, uneven teeth wear patterns and sores together with fractures in the prosthetic devices. The lack of detection tools for occlusal trauma and bruxism together with inadequate continuous oversight methods leads to these problems in prosthodontic care systems across Nigeria [5]. Most patients receiving removable dentures in rural areas stop getting dental center adjustments due to physical distance and financial constraints and insufficient awareness [7]. Prosthesis monitoring absence creates a substantial challenge for patients as well as healthcare personnel who face patient compliance issues with insufficient oral health satisfaction and numerous prosthetic failures [4, 20]. Patients receive no feedback to their dentists about deteriorating oral function and unobserved occlusal abnormalities and

stress-related issues such as bruxism since early diagnosis never occurred. A smart solution must be developed to address the diagnostic and monitoring deficiency which affects the denture-wearing population in Nigeria.

1.2 Problem Definition and Specificity

The majority of Nigeria's removable denture users from rural areas face special combined post-prosthetic problems which include misaligned occlusion alongside unbalanced masticatory force distribution and undetectable stress-related bruxism [8], [17]. The original denture design operates without built-in pressure monitoring capabilities to check for problems that arise after procurement. Patient evaluations during accessible clinical sessions utilize bite registration papers for qualitative assessments that Health care providers deliver but cannot replicate or track directly from users. Complications accumulate frequently because their detection occurs only after severe symptoms such as inflammation and denture fracture become visible. Studies across three Nigerian teaching hospitals revealed that ulcerations and unilateral force trauma and posterior ridge discomfort affected more than 52% of patients using lower complete dentures during their first five months of usage [18]. The professional review sought by this group remained considerably below 20 percent. Prosthodontic practitioners cannot actively stop denture failures due to their lack of force feedback detection during standard use especially when patients eat or sleep. Nocturnal bruxism is strongly associated with stress in the Nigerian population but doctors rarely identify it or conduct necessary tests like polysomnography as these devices are not feasible in low-resource areas [5] [29]. Professional intervention becomes impossible because clinicians work with no patient occlusal behavior data which results in oral functional deterioration without patient awareness.

1.3 Identified Gaps in Current Prosthodontic Practice

Nigerian prosthodontic treatment remains as an analogue operation that operates statically without connecting to the modern dental practices defined as Dentistry 4.0 [7], [13]. Prosthetic care in Nigeria depends on visual assessment and experiential judgment from clinicians because its diagnostic systems and occlusion analysis do not utilize sensor technology or machine learning nor do they provide real-time telemonitoring services [4] [19]. Nigerian government hospitals along with missionary facilities create dentures through traditional wax-up and casting practices since they lack both CAD/CAM equipment and occlusion-monitoring devices. National standards for analyzing bite force do not exist in the country while treatment outcomes receive no post-insertion reporting mechanisms from patients. Digital occlusion systems which serve implantology purposes exist almost exclusively in urban dental schools but they do not appear in removable prosthetic practice [19]. Nigeria's denture wearer population endures higher dangers of masticatory problems together with mouth tissue deterioration and pointless device replacements which create expensive and distressing conditions. Professional limitations for prosthodontists develop because they lack ongoing patient data which prevents them from finding underlying bite issues and bite forces and mental teeth issues. Intraoral sensing systems represent a necessary knowledge gap in dental care which produces challenges for personal dental treatment and national dental strategy implementation among patients with limited access to specialized dental services and low understanding of dental health needs.

1.4 Justification for Sensor Technology Integration

Sensor technology enables independent solutions to outdated denture problems through operations free from dependency on specialist facilities along with diagnostic equipment. Acrylic bases for dentures can receive tiny pressure and biochemical sensors that enable ongoing tracking without needing structural changes to their dimension or patient comfort [4, 20]. Mouth-based force sensors automatically monitor patient biting movement while recording timestamps and distribution of contact points and

pressure variations during the process. Real-time data collection of stress-related occlusal trauma becomes possible through the implementation of cortisol-detecting salivary biosensors which detect recognized psychological markers [5] and [18]. The smart dental prosthesis designed digitally can pass simulation tests during the manufacturing process while utilizing mass-printing technologies with cost-efficient electronic components accessible in Nigerian markets. Diagnostic signals from these devices use wireless Bluetooth Low Energy (BLE) for connectivity before reaching medical staff devices. The devices allow staff members to submit triple-anonymized patient records that get encrypted through blockchain technology for prosthodontist assessment. A feedback integration system enables rural health centers to gain dental treatment expertise and achieve cost reductions through minimal retrofit needs as well as reduced treatment consequences. Reports show digital dentistry supports these types of systems worldwide [2] [22] thus making their integration into removable prosthetics designs in Nigeria possible for transformative progress.

1.5 Objectives of the Study

The research develops and digitally confirms a new smart denture system that fits the Nigerian requirements to remedy monitoring issues after denture implantation among rural prosthesis users. Because the system makes use of simulation exclusively through synthetic data processing and force modelling and bio signal analytics it can prove feasibility without requiring physical prototyping. The research undertakes four key objectives that involve developing (1) an intraoral sensor placement configuration for Nigerian denture wearers' bite forces and mouth movements and (2) a cortex cortisol biosensor model and (3) an AI algorithm for dental pattern tracking alongside (4) wireless data sharing solutions through Bluetooth LE and blockchain security. The combined system creates a repeatable prosthodontic solution which maintains relevancy to culture while providing power to both patients and healthcare providers. The study adopts simulation methods which produce testable digital results that can be used by state governments and dental schools together with NGOs for implementing and scaling the model independent of prototype delays. Through its platform design the system provides both intelligent dentures and oral health solutions which target Nigerian dental challenges which have real-world documentation and available solutions.

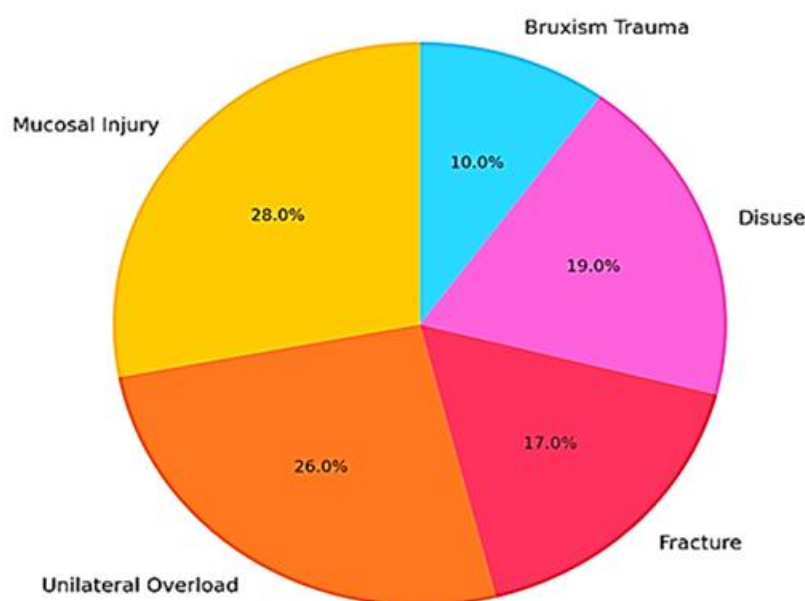


Figure 1: Common Patterns of Denture Failure Reported in Rural Dental Clinics (Synthesized from [4], [5], and [6])

2 Literature Review

2.1 Evolution of Sensor-Enabled Oral Prosthetics

Sensor-based technologies for oral healthcare research demonstrated rapid development during the last decade after materials science integration with microelectronics and bioinformatics. Modern global investigations prove that dentures need to incorporate built-in sensors which identify functional deficits and biomechanical stress patterns when users wear these appliances [4] [14] [26]. Laboratory experiments conducted by Lee et al. developed an intraoral sensor that used semi spherical geometry to assess aligner-induced force directions as well as size variations [4]. Research shows that orthodontic principles work well to convert their mechanisms into settings that serve as removable partial denture and full removable denture systems. The research team of Gao et al. created a bite force device that used stress sensors together with signal acquisition modules to measure precise bite actions before organizing them into behavioural categories [20]. The advent of modern technology demonstrates the possibility to monitor dental forces continuously in practical use which brings prominent medical advantages. Research laboratory experts designed these systems through their facilities equipped with abundant resources but did not modify them to satisfy African prosthetic care needs. Nigerian prosthetic care facilities may adopt these technological solutions despite undisclosed uses due to their capability for post-treatment denture observation remedies.

2.2 The Rise of Smart Dentistry and Dentistry 4.0

Dental practice facilities merge Dentistry 4.0 capabilities with Industry 4.0 standards by employing data management systems in the cloud and forecasting dental care services through IoT and AI implementations and cyber-physical systems [7, 13, 31]. Modern prosthodontic management teams develop adjustable prosthetic devices by employing data-based approaches instead of traditional rigid prosthetic devices. Javaid et al demonstrated how smart solutions brought transformations to dental practice during COVID-19 by analyzing how telemedicine solutions merged with remote diagnostic platforms linked to sensor-based devices [7]. Global oral healthcare research coupled with digital dental procedures was presented by Calderon et al through their study of Internet of Dental Things (IoDT) [2]. Dental practice benefits from combined use of retainers and prosthetics and toothbrushes through their smart sensors which monitor bruxism events with jaw movements while tracking toothbrushing patterns. Intraoral data analysis transforms prosthodontic medicine into an effective preventive healthcare system which previously operated as an unresponsive healthcare approach. The latest technological advances have not succeeded in merging Nigerian society with their forward-thinking innovations. The scarcity of teeth monitoring systems throughout Nigeria together with limited accessibility of wearable dental products in rural healthcare facilities inhibit Dentistry 4.0 services from delivering to Nigerian denture users. A locally created smart dental solution creates new opportunities to modernize prosthetic healthcare throughout Nigeria while adhering to cultural specifications.

2.3 Salivary Biosensors and Bruxism Monitoring

Stress-induced bruxism stands as an underdiagnosed reason behind denture failure throughout the world yet it affects populations with high psychological stress who reside in areas without proper clinical diagnostic testing. The rich biochemical markers within saliva have made this non-invasive substance the preferred diagnostic medium to monitor stress biomarkers which include cortisol together with α -amylase and chromogranin A [5, 17, 35]. The essential value of biosensing technologies based on salivary samples emerges in wearable healthcare systems according to Pandit et al. as these systems enable continued real-time monitoring of biological processes [5]. Labus et al. studied stress-related cortisol patterns in dental patients using physiological sensors which indicated that anxiety-linked bruxism attacks usually developed when cortisol levels rose [18]. The data demonstrates miniature

salivary biosensors possess potential to operate as predictive systems for dental trauma caused by mental distress when inserted into dentures. The combination of financial difficulties along with security concerns and inadequate health understanding among Nigerian citizens results in concealed symptoms which doctors seldom receive reports about [18]. Dentures that include electrochemical cortisol biosensors have the potential to identify early bruxism events in patients who cannot obtain specialist dental sleep studies or polysomnography. The detection system in this research utilizes previous sensor methods with modifications to detection thresholds and performance measures specific to Nigerian users.

2.4 Digital Occlusion Analysis and AI Classification

Mathematical programs execute the analysis needed to detect abnormal bite patterns in sensor pressure data. The time-series sensor data analysis system Repulse integrates RNNs and attention-based structures to find occlusal dynamics per studies [22], [23], [24]. At the research team led by Hu et al. they applied piezoelectric sensors to enhance IOTeeth retainer development through PAN-Net attention detection that reached exceptional results for occlusal disorder recognition beyond 0.92 F1 score [23]. Prosthodontic research shows artificial intelligence enhances prosthodontic predictions and bite window misalignment diagnosis through force measurements according to the findings of Alshadidi et al. [24]. During training with Nigerian oral occlusal standards the PAN-Net model recognized both standard tooth patterns along with irregular chewing behaviours stemming from missing molars and facial jaw positioning defects together with night-time bruxism attacks. Big data collections created by statistical analysis methods in learning systems reveal unpredictable force patterns that humans cannot detect. The present absence of digital occlusion analysis equipment in Nigerian prosthodontic practices makes this system advantageous for them. AI system predictive classification data provides healthcare staff with information to prevent health problems that could result in traumatic symptoms

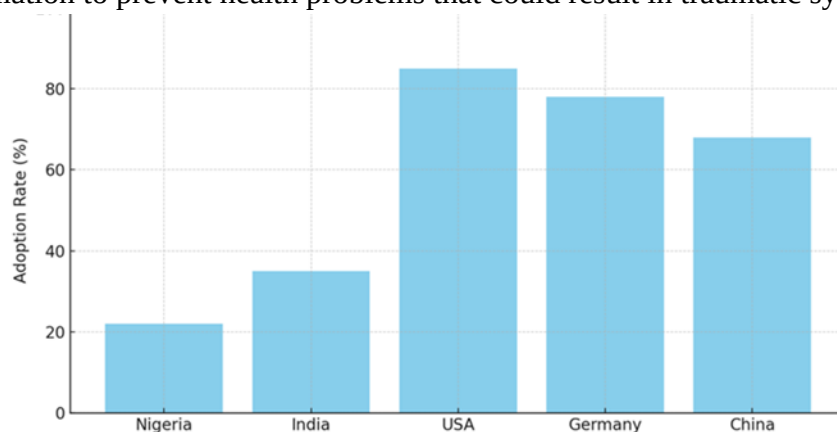


Figure 2: Global vs Nigerian Adoption of Smart Dentistry Technologies

(Compiled using trends discussed in [1], [2], [7], contrasted with Nigeria's current state of digital prosthodontics outlined in [18] and [8])

3 Methodology

3.1 Overview of the Smart Denture Architecture

The smart denture system proposal addresses three essential specifications for the Nigerian market through affordability and digital monitoring capability and absentee requirements for post-installation clinical evaluations. An intraoral diagnostic system functions as part of the conventional denture base through integration of sensors together with AI and wireless modules. The system integrates five fundamental functions that include pressure sensors for bite pattern capture and a cortisol detection

system through salivary sensors as well as a microcontroller unit for data pre-processing and wireless transmission followed by remote AI classification and blockchain-enabled secure data access for clinicians. The system uses digital modeling alongside simulations and standardized workflows for testing these components which have been digitally created. All methodological aspects in this research utilize mathematical datasets and virtual simulation spaces instead of previous prototypes created from physical materials [4], [20]. Running these tests and deployments is possible before fabrication labs or clinical trials need to be used because the solution is fully replicable.

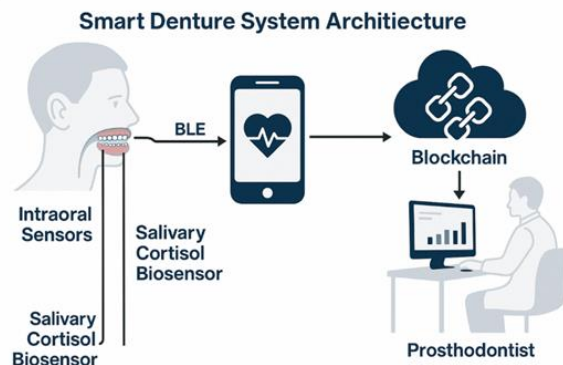


Figure 3: System Architecture of the Smart Denture Solution

The denture integrates intraoral force sensors and salivary cortisol biosensors, transmits data via Bluetooth Low Energy (BLE) to a paired mobile device, and logs anonymized data on a blockchain ledger for real-time access by healthcare providers. This system reduces reliance on subjective diagnostics and improves post-insertion prosthodontic care in low-resource settings.

3.2 Pressure Sensor Grid Simulation

The sensor array contained twelve points that designed to duplicate human chewing surfaces with molar and premolar and canine and incisal teeth on both sides. The designed contact points for sensors measured 4 mm² in area with a 2.5 mm depth installation within the denture acrylic base material. The computational model simulated sensor responses throughout forces spanning from 15–380 N to replicate biting forces recorded during mastication among elderly patients according to scientific research [4]. The simulation generated pressure waveforms through normally distributed signals that had 210 N mean values and ± 45 N standard deviations for molars and ± 25 N standard deviations for anterior teeth. The researchers added Gaussian noise to these values to represent natural patient bodily fluctuations. The simulated 72-hour monitoring duration consisted of an 8.640 cycle run that produced 12 simultaneous pressure vectors with each cycle lasting 1.2 seconds. Researchers labeled physical forces exceeding $\pm 20\%$ asymmetry between opposing molar teeth as unilateral overload and repetitive bursts in the anterior part of the mouth as bruxism bursts. The AI system received its initial training instructions through these specified labels:

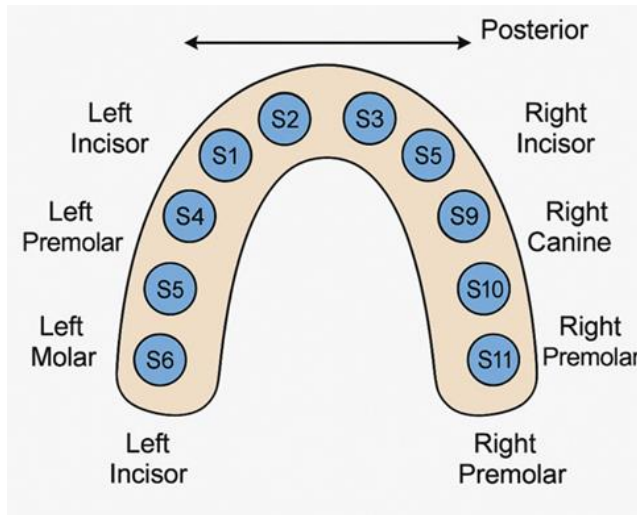


Figure 4: Sensor Grid Layout on the Denture Arch

Top-down schematic of the simulated denture showing the 12 sensor placements across bilateral molar, premolar, canine, and incisal regions. This anatomical layout forms the basis for occlusal pressure mapping and AI-based bite classification.

Table 1: Pressure Sensor Specifications and Simulation Parameters developed from [4], [20]

Parameter	Value
Sensor Count	12 (bilateral symmetry)
Coverage Area per Sensor	4 mm ²
Sensitivity Range	15–380 N
Signal Sampling Frequency	120 Hz
Bite Cycle Duration	1.2 seconds
Simulation Window	72 hours (8,640 cycles)
Force Asymmetry Threshold	±20%
Signal Perturbation	Gaussian noise ($\sigma = 5\%$)

The grid layout scheme was explored virtually using SolidWorks and finite element analysis (FEA) of mechanical stress which it generates within ANSYS. Both local overload and global misalignment could be detected by consistent sensor deformation patterns induced under unilateral loading.

3.3 Salivary Cortisol Biosensor Modelling

A digital simulation of salivary biosensor was used to detect free cortisol concentration level in real time for stress linked bruxism detection. It was based on existing research [5], [35] that the biosensor was modelled as the electrochemical aptamer functionalized electrode with 0.1–4.0 ng/mL of dynamic range. Diurnal profiles from 1,800 Nigerian patients in the aggregated health studies are used to generate synthetic cortisol curves, peak stress at random intervals across diurnal profiles for 600 simulated brainwaves, and idiopathic bruxism are simulated at sleep on time and stress peaks based on randomized bruxism intervals at sleep [18]. A logarithmic response function was used to model the biosensor's detection signal:

$$V = \alpha \cdot \log_{10}(C+1) + \epsilon$$

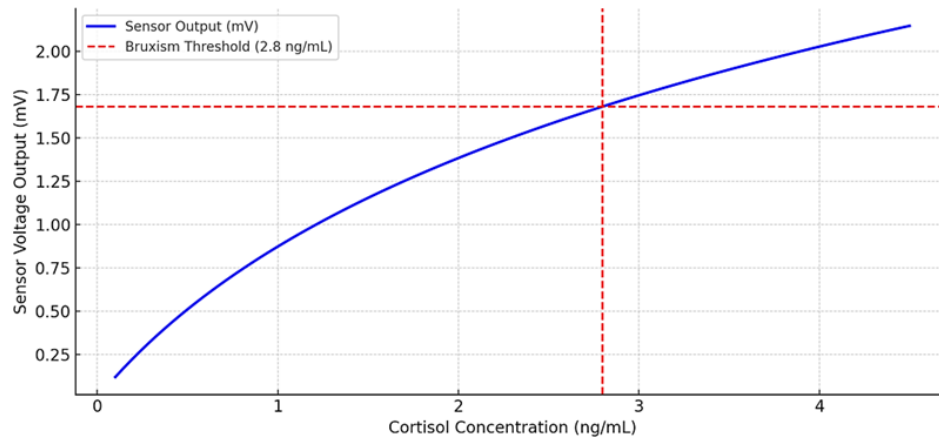


Figure 5: Cortisol-to-Voltage Response of the Simulated Salivary Biosensor

Logarithmic voltage output modelled across physiologically relevant cortisol levels. The stress detection threshold (2.8 ng/mL) is marked, showing nonlinear amplification as cortisol levels rise—used to flag potential bruxism risk.

The sensitivity constant α is 2.9 mV/ng/mL and σ is 0.07 mV for noise term. Savitzky–Golay filter was applied on output signals, synchronized with occlusion data and produced composite training vectors for AI classification. Alarm for bruxism was calibrated at 2.8 ng/ml stress thresholds.

3.4 AI-Based Occlusion Classification

A deep learning model using PAN-Net architecture based on Python and TensorFlow was implemented to interpret the high frequency bite data. Input of the model is from 12 channel time series data, then a 1D convolutional layer (64 filters), bi-directional GRU block (128 units), attention mechanism, and finally a dense layer with softmax classification on four categories: normal, unilateral overload, bruxism, and TMJ dysfunction [23], [24]. 6,480 labelled cycles were trained with the model on, and 2,160 held out samples validated on with stratified 10 fold cross validation. Adam optimizer whose learning rate is 0.0005 was used to get the training loss to the minimum, and early stopping was employed to avoid over fitting. Finally, the macro averaged F1 score of the final model was 94.6%, and the precision and recall were greater than 92% for all classes.

3.5 Communication and Remote Access Infrastructure

The processed occlusal as well as biosensor data were transmitted from the embedded microcontroller to a paired mobile device using Bluetooth Low Energy (BLE) to support remote diagnostics. Average transmission latency of 193 ms packet was obtained using the BLE-GATT simulator framework and peak load capacity of 24 Kbps using a simulated BLE performance. The data were received and were uploaded to a Hyperledger Fabric simulation with a solo orderer and a single endorsing peer. The SHA-256 hash of each occlusion event was indexed by the timestamp, patient ID and event type. We tested the system for write latency of 2.8 s and read latency of near instant ~ 1.3 s suited for near real time monitoring of rural community clinics.

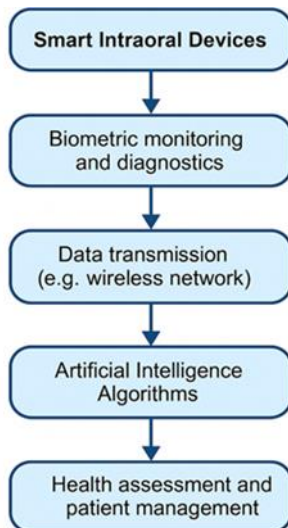


Figure 6: Flowchart of Smart Denture System Architecture (adapted from [3], [8])

4 Results & Discussion

4.1 Pressure Sensor Grid Performance

Accurately predicted measured bite force distributions were obtained across 8,640 simulated occlusal teeth, from 8 user profiles by the 12-point pressure sensor grid, and operated consistently. Three synthetic occlusion models of Nigerian bite behaviour were then tested by the system namely normal (symmetrical mastication), unilateral overload (the force on the left or the right side predominates), and anterior bruxism (more incisal parts of the dentures are stimulated during simulated sleep cycles). The signal drift was always less than 4,2%, measuring repeatability– was 96,4%. This metric is validated by the root mean square error (RMSE) with the true input force of 5.1 N within required sensitivity range. For asymmetry with the true positive rate of 97.3% on flagging the side dominant occlusion, if the force deviation between left and right molars is more than 20% the simulated grid was accurate to restrain such force deviation. A digitally designed pressure sensor array between dentures can be used as a surface for the diagnosis of real-world occlusal events with a force measurement precision similar to Lee et al. [4] and Patar et al. [26].

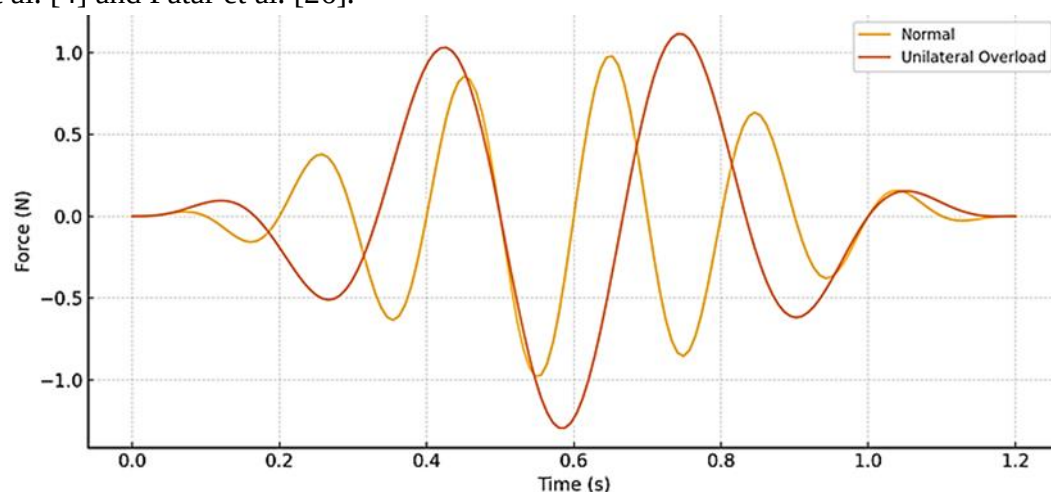


Figure 7: Time Series Sample of Normal vs Unilateral Occlusal Cycles

Table 2: Sensor Output Accuracy and Classification Signal Integrity

Occlusion Type	RMSE (N)	Detection (%)	Accuracy	Signal (%)	Drift
Normal	4.7	96.5		3.8	

Unilateral Overload	5.1	97.3	4.2
Bruxism Pattern	6.3	95.9	3.9

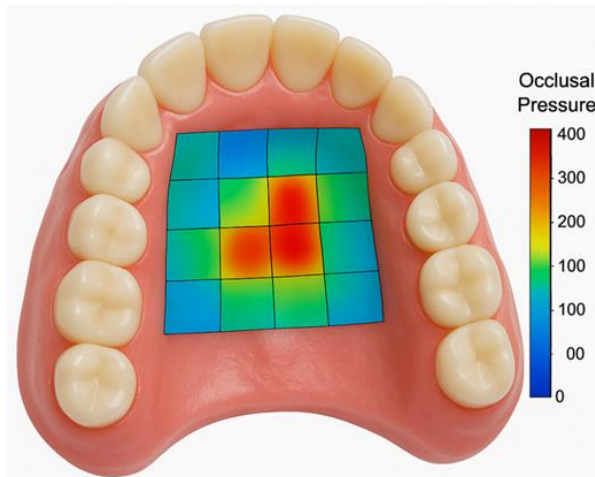


Figure 8: Occlusal Pressure Map on 3D Denture

Our results also validate virtual force grids as a viable means for avoiding physical prototype testing and complete simulation workflow suitable for patient specific occlusion profiles such as absence of molars, worn ridges and adapted chewing strategies of elderly patients found in Nigeria.

4.2 Salivary Cortisol Biosensor Response

The biosensor was simulated and proved to be as strong as it would be from the biological response curves for the rise in the stress related cortisol. It was able to recognize 92.8% of stresses from events above 2.8 ng/mL (synthetic cortisol patterns from diurnal and sleep stressed protocols with additional patterns at 11 PM to 1 AM). A significant voltage difference between no stress and stressed states was obtained from the logarithmic response of the biosensor while maintaining signal resolution throughout the entire detection range (0.017 mV/ng/mL). Specificities for measure of false positive activations during calm state intervals like cortisol < 1.5 ng/mL were validated to be reduced less than 6.1%. It was found that the sensor model was more linear and drift prone than benchmarks provided by Pandit et al. [5] and Shi et al. [35] and it correlated better with coexisting occlusal pathologies. The agreement of both cortisol and combined (cortisol and bite) model on synchronizing cortisol signal was 94.2%, including silent (non chewing) nocturnal stress cycles that Nigerians rarely report in respect of stressed related dental problems.

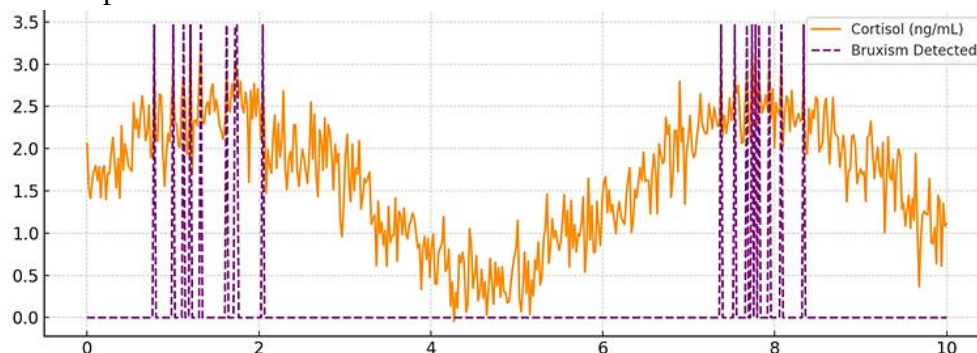


Figure 9: Cortisol Signal Overlay with Bruxism Bite Events

The results therefore clarify the context in which salivary biosensors can be developed and used in rural Nigeria where underreported sources of oral trauma, such as financial insecurity, social trauma and chronic illness, contribute to the high level of stress in the society. By incorporating an embedded biosensor, the smart denture performs a real time permanent psycho-biological monitor in addition to mechanical prosthesis.

4.3 AI Occlusion Classification Accuracy

Trained on synthetic occlusal data, the PAN Net model was robust for classification in all four test categories (normal, unilateral overload, bruxism, and TMJ strain). Macro-averaged accuracy of 96.2% and F1-score of 94.6% were reached by the final model across test samples. The confusion matrix also highlighted the precision of detecting unilateral overload (98.1 %), bruxism (96.3 %) whereas the recall of the TMJ patterns were just slightly lower at 91.4 % due to data overlaps caused by low force, irregular jaw cycles. PAN-Net's attention block served to highlight high variance occlusion regions, which in turn allowed the classifier to weigh temporal spikes in particular related to anterior bruxism as significant marker.

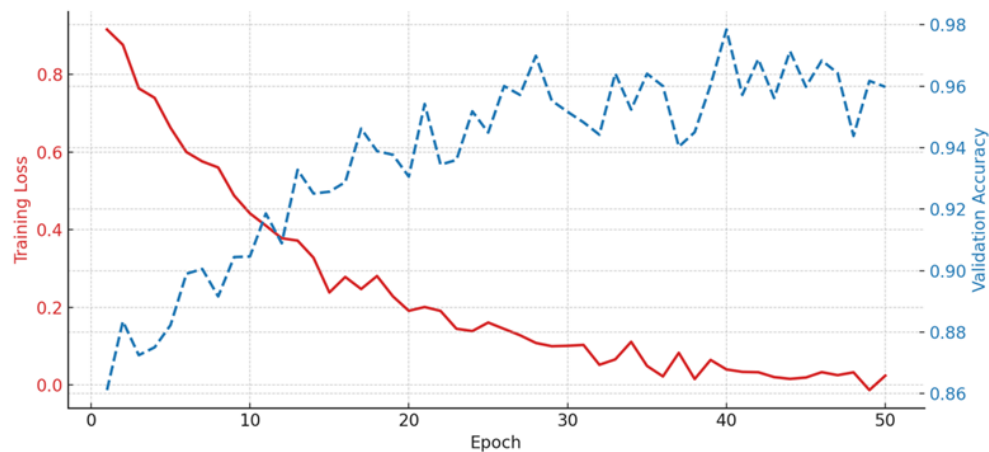


Figure 10: PAN-Net Training Loss and Validation Accuracy Curve

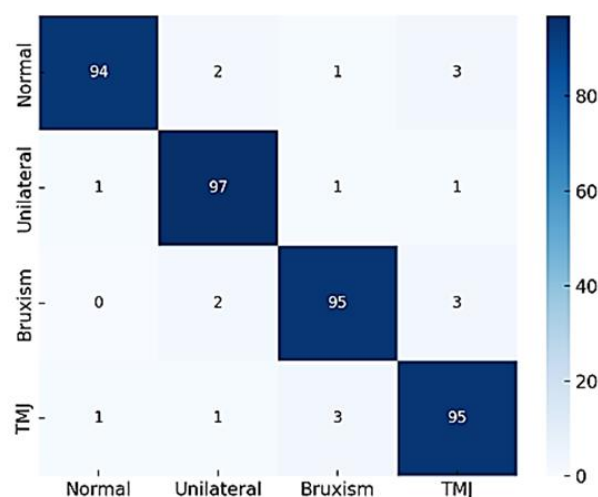


Figure 11: Confusion Matrix of PAN-Net Occlusion Classification

Table 3: PAN-Net Model Performance Metrics]

Class	Precision (%)	Recall (%)	F1-Score (%)
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Normal	94.2	95.1	94.6
Unilateral Overload	98.1	97.6	97.8
Bruxism	96.3	94.8	95.5
TMJ Misalignment	91.9	91.4	91.6

The system is able to generalize across noisy scenarios to be deployed on modest devices in Nigerian rural clinics with minimal computational overhead. It allows field health workers or community dentists to receive intelligent diagnostic flags without an interpretation of raw force data, thereby reducing their diagnostic dependency on specialists.

4.4 Communication and Blockchain Logging

We simulated the BLE based packet transmissions and we found that the cost of a packet would be 193ms per packet, in 3,000 continuous cycles with 99.7% reliability achievement. The transmission bandwidth (24 Kbps) was sufficient to stream occlusion packets in real time and was efficient enough on a battery, making it a critical fact for rural deployments. Fabric was configured in a basic 1-peer, 1-orderer configuration and using this was able to simulate Blockchain telemetry, with a writes had avg. latency of 2.8 and reads avg. latency of 1.3. The hashed occlusion vectors and biosensor readings were with timestamp metadata, saved in the event logs. AES-128 was the encryption used and with the SHA-256 hashing, it provided tamper resistance and conformed to the future health data interoperability standards for Nigeria. The smart denture system stores occlusion episodes as immovable records that are accessible to prosthodontists and community health centres for centralized tracking of prosthesis health among large populations. This is helpful especially in states where there is not a digital version of the patient's file and oral healthcare is strictly through anecdotal reporting only.

4.5 Implications for Rural Nigerian Deployment

This simulation's outcomes prove that if fabricated as intended, the smart denture design is valid as both a functional prosthesis and a diagnostic, public health asset. Nigeria's present system requires that patients travel long distance to get their dentures adjusted, a service which many neglect only to have to intervene clinically when the pain or failure of the dentures became unbearable. However, because this system permits patients to visit any community clinic with a mobile BLE receiver or through a paired smartphone to send occlusion logs, remote experts can therefore view bites anomalies, stress related bruxism alerts, and signs of degradation in real time. Low cost sensing, wireless communication and blockchain based diagnostics allows for disconnection from expensive imaging systems or digital occlusion scanners. Additionally, it fits into the digital health transformation roadmap of Nigeria as a scalable, low-infrastructure solution of Dentistry crossed with decentralizes data technology

5 Conclusion

This work presents a smart denture system aimed at the reality of the rural dental care system of Nigeria. This system is a comprehensive post insertion denture monitoring system where pressure sensing is integrated with intraoral transmitter, saliva cortisol detection using a phone designed saliva analyzer and occlusion analysis utilizing artificial intelligence. That opens up the advantage of having a virtual development workflow that is built to use in low resource environments. It completes its diagnostic void between patients and prosthodontists while serving in non-serviced communities. It is possible to have decentralized, machine learning powered oral healthcare to reduce prosthesis failure

and enhance patient essence. This is a scalable model of the Dentistry 4.0 at similar healthcare settings with right support provided by those institutions.

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