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DIETARY PLANNING SYSTEM FOR ATHLETES

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Abstract:
The growing demand for personalized nutrition in sports has encouraged the development of intelligent **expert systems** capable of enhancing dietary planning and recommendations for athletes. This study presents the design and implementation of an Automated Dietary Planning System for Athletes (DPSFA), an **expert system** that generates accurate, efficient, and personalized meal plans by considering variables such as age, gender, sporting discipline, training intensity, and health status. The system's architecture incorporates expert system methodologies and decision-support algorithms, enabling automation of the diet planning process while minimizing human error and ensuring consistency. Data for system development were obtained from consultations with nutritionists and healthcare professionals, supplemented with secondary online research. The system was implemented using PHP, JavaScript, and MySQL, and it features a secure, interactive interface that supports user registration, authentication, meal plan creation, and diet tracking. Insights from the literature review highlight the significance of such **expert systems** in improving athletic performance and overall health outcomes. The deployment of ADPSA demonstrates a practical framework through which dietitians, coaches, and athletes can effectively manage nutritional objectives, with the flexibility to make quick adjustments during training or competition. This study concludes that expert system–based computerized diet planning is a vital tool for optimizing sports performance and recommends its broader adoption across both professional and amateur sports environments.

Keywords: *Sports nutrition, diet-planning system, expert system, personalized nutrition, athlete performance.*

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1.0 Introduction

Nutrition plays a fundamental role in human health, disease prevention, and performance optimisation. A **diet** is broadly defined as a specific selection or pattern of food consumption that an individual adheres to for reasons such as weight management, medical treatment, or athletic performance (Oxford Dictionary, 2022). The concept extends beyond food restriction to encompass the deliberate intake of balanced nutrients essential for maintaining physiological

well-being and achieving specific health or performance outcomes.

A **balanced diet** emphasizes the consumption of nutrient-rich foods, including fruits, vegetables, whole grains, and low-fat or fat-free dairy products, alongside diverse protein sources such as lean meats, fish, poultry, eggs, legumes, soy-based products, nuts, and seeds. At the same time, it limits the intake of unhealthy components such as added sugars, sodium, saturated fats, and cholesterol (WHO, 2021; U.S. Department of Health and Human Services, 2020). Research confirms that balanced nutrition not only ensures an adequate supply of calories, proteins, vitamins, and minerals but also supports long-term health and reduces the risk of chronic conditions such as cardiovascular disease, diabetes, and obesity (Holman et al., 2008; Franz et al., 2017).

Athletes, however, have **specialized nutritional requirements** that differ significantly from those of the general population. Due to the physical demands of training and competition, athletes require higher caloric intake and macronutrient distribution to sustain energy, enhance recovery, and optimise performance (Burke et al., 2011; Thomas, Erdman, & Burke, 2016). In addition to energy balance, proper **meal timing** and hydration strategies are crucial in maximising glycogen stores, preventing fatigue, and supporting muscle repair (Sawka et al., 2007). The integration of carbohydrates, proteins, fats, vitamins, and minerals into personalised nutrition plans tailored to sport type, training load, body composition, and health status has been shown to significantly improve athletic outcomes (Maughan et al., 2018; Ismail, Rahman, & Abdulla, 2019).

With the advancement of technology and the growing field of **personalized nutrition**, computerised and intelligent dietary planning systems have emerged as important tools in sports nutrition. Expert systems and decision-support algorithms are increasingly applied to design dietary frameworks that minimise human error, provide consistency, and allow for real-time adjustments (Zainuddin, Rahmat, & Yusof, 2020; Chukwunonso, Yusuf, & Godwin, 2020). Such systems enable athletes, coaches, and dietitians to adopt data-driven approaches to dietary planning that reflect individual needs and dynamic training environments. Theoretical foundations of expert systems emphasise their capacity for knowledge management and decision-making (De Tore, 1989; Ghazanfari & Kazemi, n.d.; Leondes, 2002).

Given the increasing interest in **digital health innovations** and their application in sports, this study introduces the **Automated Dietary Planning System for Athletes (**DPSFA**)**. The system leverages expert system methodologies and software technologies to generate customised meal plans based on an athlete's demographic profile, sport type, training intensity, and health condition. By combining nutritional science with computer-based intelligence, the proposed framework contributes to the optimisation of athletic performance and the promotion of healthier sporting practices.

2.0 Literature Review

The literature examined in this chapter focuses on various aspects of nutrition and exercise, including daily dietary requirements for training, the role of carbohydrates in exercise, pre-event meals, the relationship between glycemic index and athletic performance, protein's impact on sports performance, the use of nutritional supplements to enhance performance, and the importance of hydration in sports. The rise of computerised diet-planning systems tailored for athletes is becoming increasingly important as the demand for personalised nutrition in sports grows. These systems are designed to automate and optimise diet planning based on specific parameters related to the athlete, such as age, gender, type of sport, training intensity, and health status.

Consequently, Zainuddin et al. (2020) noted that incorporating expert systems and decision-support algorithms can lead to more efficient nutritional planning for athletes, minimising human error and facilitating quick recommendations. Their research resulted in a web-based nutrition planner that considers metabolic rates and recommended dietary allowances. Similarly, Ismail et al. (2019) introduced a mobile meal recommendation system called iDietScore™, which generates meal plans for athletes based on various input parameters, including activity level, food preferences, and performance objectives. Such digital support systems are essential for ensuring adherence to nutritional guidelines and monitoring. Nwanekezie and Ugbajah (2018) highlighted the significance of personalised meal planning in improving athletes' performance and recovery. Their computerised system provided real-time feedback and utilised nutritional databases to offer balanced dietary recommendations, leading to increased athlete satisfaction with customised diets.

Abdullah (2017) developed an online diet planning system aimed at general users, with potential adaptations for athletes. This system utilised BMI calculations, caloric needs, and health conditions to create meal plans. Although not specifically designed for athletes, the foundational approach can be tailored for sports applications with further customisation. Chukwunonso et al. (2020) emphasised that computer-based nutrition support systems are particularly beneficial in sports settings where quick dietary adjustments are necessary during competitive seasons. These systems assist dietitians in maintaining consistent nutritional quality and preventing the over- or under-prescription of nutrients. Expert systems have also been widely applied in healthcare, including heart disease, asthma, and breast cancer diagnosis, showing their reliability for decision-support applications (Adeli & Neshat, 2010; Fazel-Zarandi, Zolnoori, Moin, & Heidarnejad, 2010; Keles, Keles, & Yavuz, 2001). Their success provides a foundation for applying similar methodologies in dietary planning for athletes.

3.0 Materials and Methods

3.1 Research Design

This study adopted a **system development research design**, focusing on the design, implementation, and evaluation of an Automated Dietary Planning System for Athletes (DPSFA). The methodology combined both qualitative and quantitative approaches. Qualitative insights were obtained from nutritionists, dietitians, and healthcare practitioners through interviews and consultations, while quantitative aspects involved algorithmic modelling of dietary needs using nutritional standards and data-driven computations.

3.2 Data Collection

Primary Data – Consultations with professional nutritionists and sports health experts provided domain-specific knowledge, including recommended dietary intake (RDI), macronutrient ratios, hydration guidelines, and timing of meals for different categories of athletes.

Secondary Data – Information was gathered from scientific journals, textbooks, and online nutritional databases, such as the World Health Organisation (WHO) dietary guidelines and the United States Department of Agriculture (USDA) nutrient recommendations. These resources informed the knowledge base for the expert system.

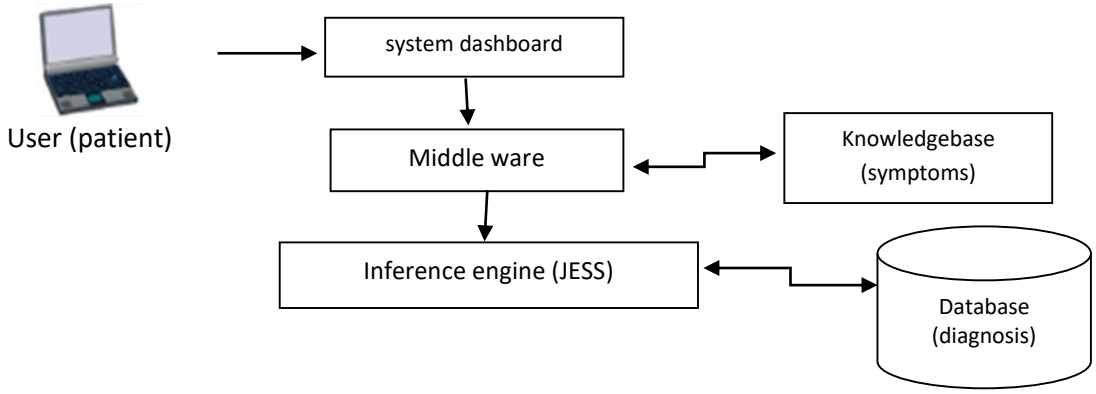


Figure 1: Medical expert system architecture

The system architecture follows the conventional structure of an **expert system** with four major components:

User Interface – Facilitates user interaction through registration, login, diet input, and meal plan visualisation.

Knowledge Base – Stores nutritional rules, dietary guidelines, and athlete-specific requirements.

Inference Engine – Processes user input (age, gender, sport type, training intensity, and health status) against the knowledge base to generate tailored dietary plans.

Database Layer – Maintains user records, dietary histories, and tracking data for performance evaluation.

3.3 Design Methods

This study was completed by gathering information from multiple sources. One of the most valuable contributions came from oral interviews with nutrition staff. Additionally, consultations with doctors and nurses offered crucial technical knowledge, especially on matters related to patient nutrition. Moreover, the internet served as a rich source of information, offering details that were crucial for analysing key topics. Numerous websites provided vital information related to dietitian records and diagnoses.

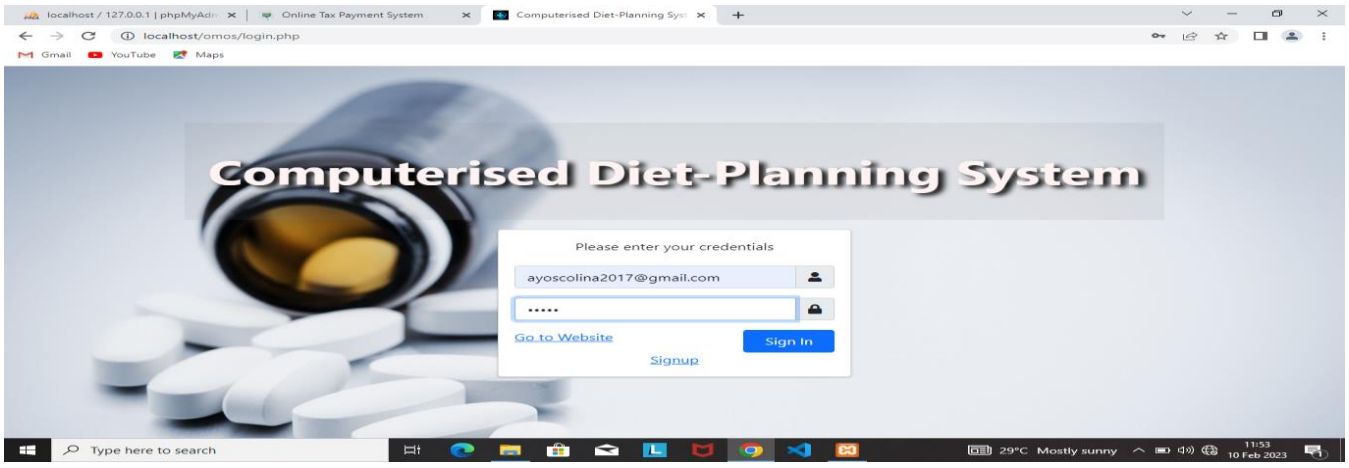


Figure 2: User Login Page

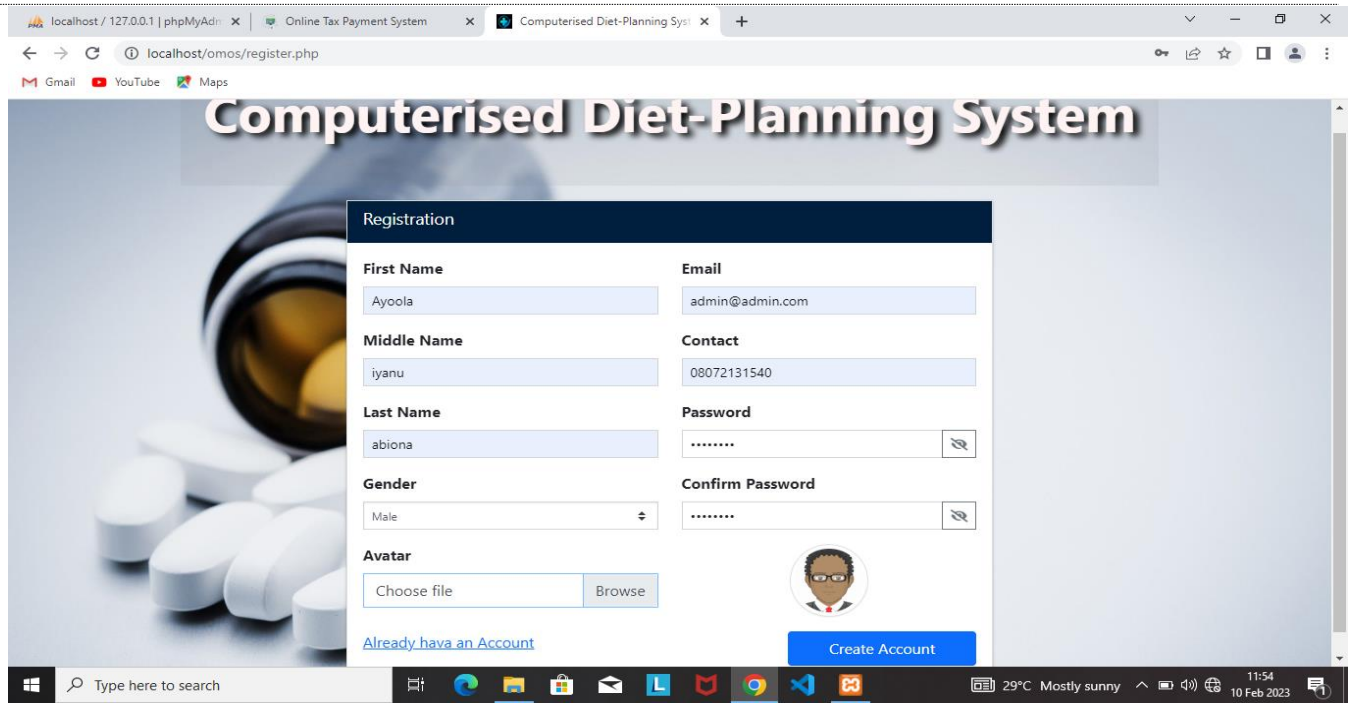


Figure 3: Registration page

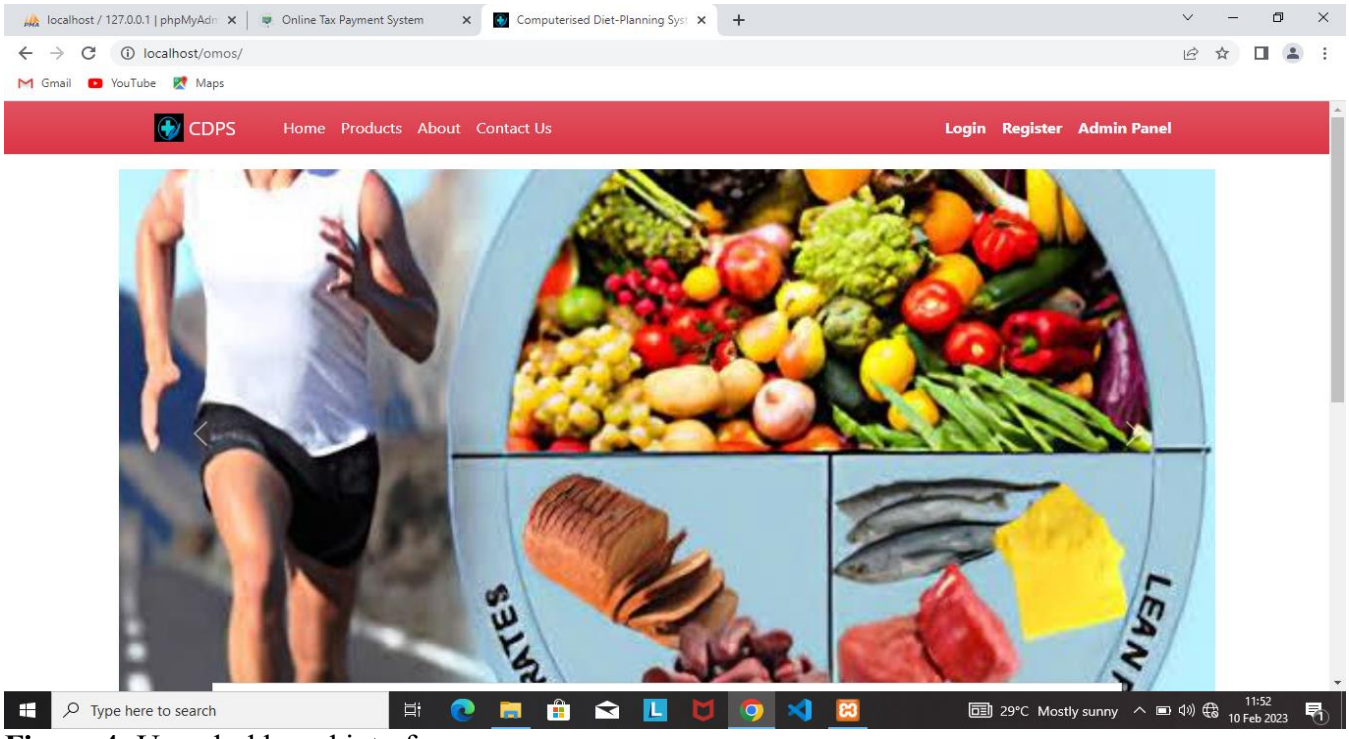


Figure 4: User dashboard interface

The user registration board shown in Figure 3 controls access to the designed system. It allows authorised and disallowed unauthorised access, thereby ensuring system security, data integrity

and preventing data loss. The interface is used by the users to gain unlimited access to the system. Figure 4 illustrates the interface containing all components, including the modules and menus of the expert system. It displays registered patients, as well as those who are undiagnosed or diagnosed alongside a system user menu. This interface grants the system administrator full access and control over the expert system. It also allows the administrator to view diagnosis results for any patient.

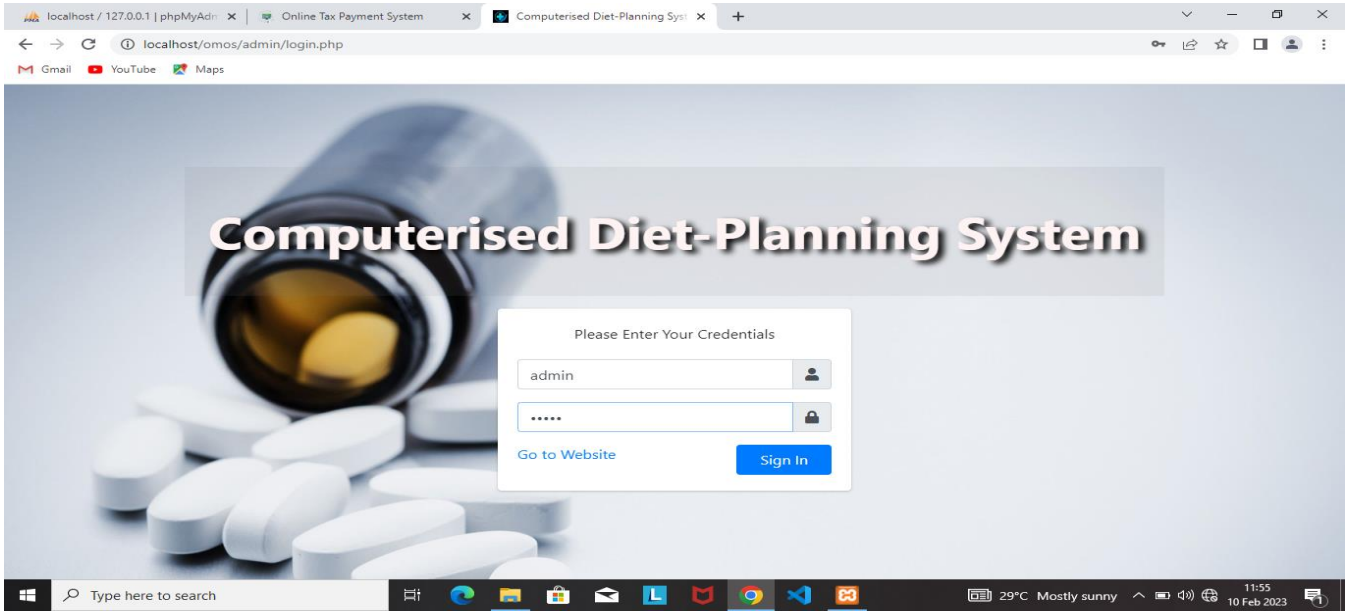


Figure 5: Admin Login Page

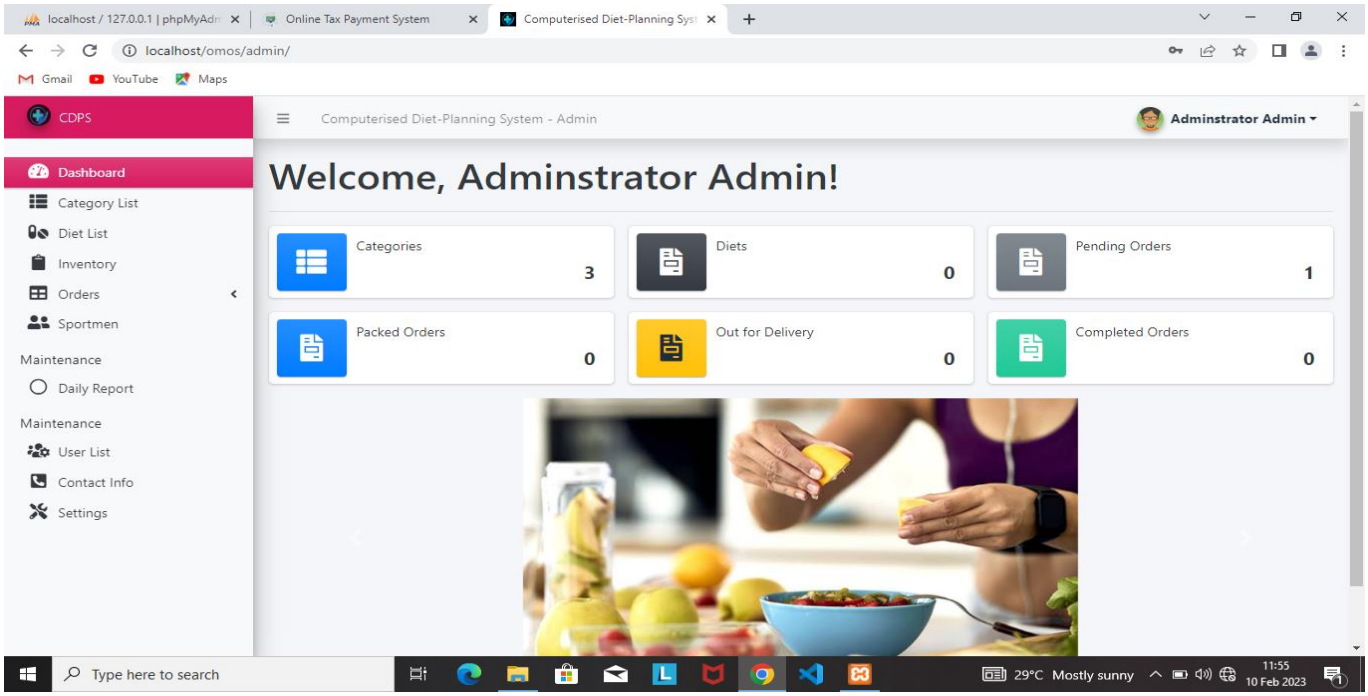


Figure 6: Admin dashboard

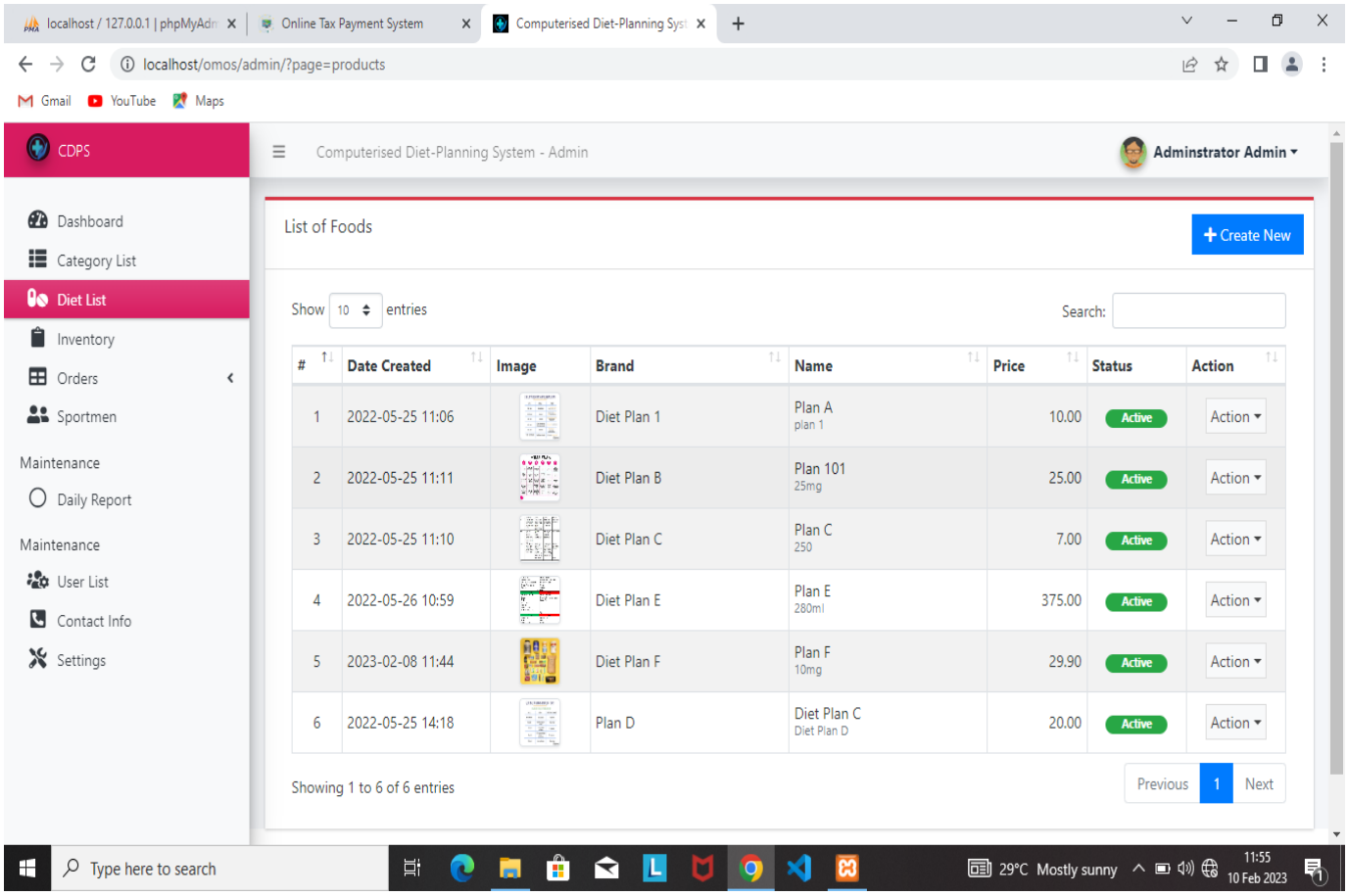
The designed interfaces of the expert system for diabetes diagnosis are categorised as:

i. Patient Record Interface
ii. Diagnosis Interface

The interface depicted in Figure 6 displays all components, including modules and menus of the expert system. It features registered patients, as well as both undiagnosed and diagnosed patients, along with a menu for system users. This setup allows the system administrator complete access and control over the expert system, providing a platform for the administrator to view the diagnosed results for any patient.

Figure 7: List of Diet-Plan Interface

This interface, shown in Figure 7, contains the information of all registered diet plans for Sportsmen



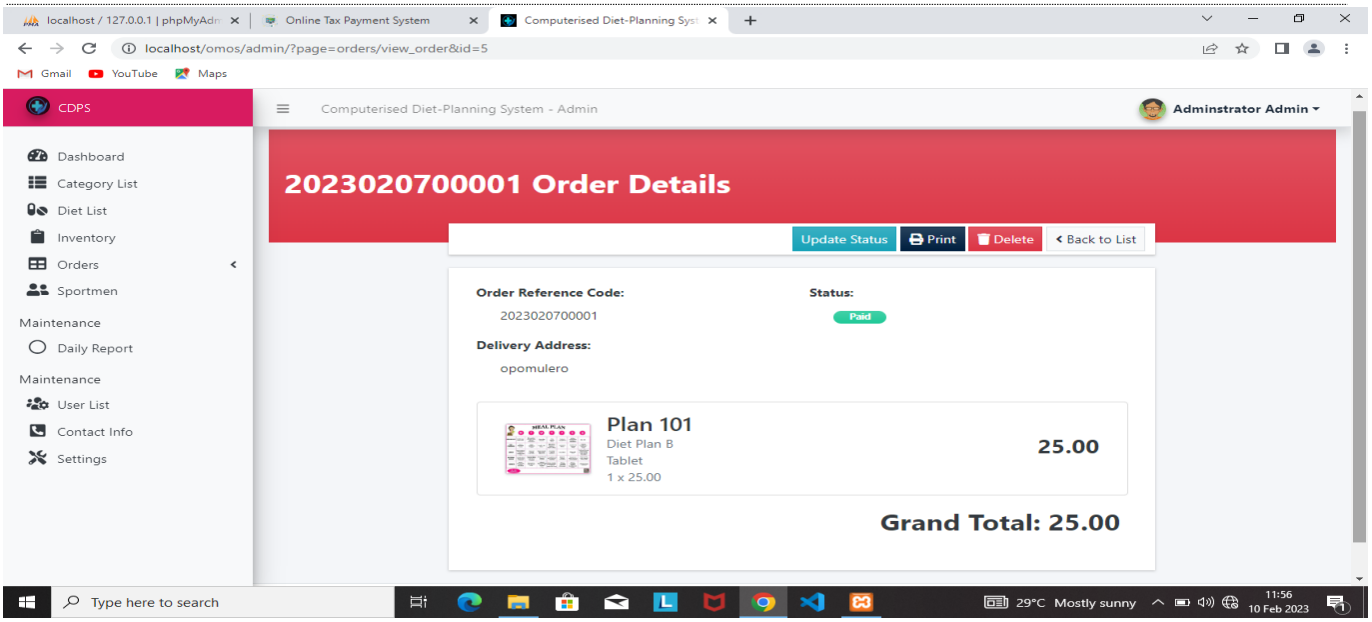


Figure 8: Order Details Page

Figure 8 illustrates the structured sequence of meals prescribed for a specific dietary plan. It represents an administrative order management interface used to view and manage customer orders in a food, nutrition, or diet planning system.

4.0 Conclusion and Recommendation

A diabetes dietitian offers tailored, evidence-based nutritional advice to individuals with diabetes, considering factors like their nutritional condition, medications, diabetes control strategies, and overall lifestyle. We collaborate with diabetes specialist nurses (DSNs) and diabetes consultants to achieve optimal diabetes control through a comprehensive understanding of the condition and effective medication use when necessary. Our goal is to minimise the risk of complications associated with diabetes, such as cardiovascular disease and kidney failure. For patients with pre-existing kidney issues, we coordinate with our colleagues in the renal department to enhance dietary care and ensure consistent dietary advice. We see patients referred to us in both hospital and outpatient settings by diabetes consultants. Through the diabetes website, patients can easily self-diagnose, learn about prevention, precautions, dietary control, and the causes of diabetes.

Access to medical services in rural areas, particularly in developing countries, is severely limited. Medical expert systems, such as dietitian websites, can significantly help address this issue by providing decision support for diagnosis, treatment, and diabetes management. This study developed a prototype for diabetes management, a chronic condition affecting millions worldwide. Initial evaluations indicate that such a system could be beneficial in expanding medical services globally and serve as an educational resource for untrained medical personnel. Evidence from chronic disease management demonstrates that computerised systems improve patient adherence and health outcomes (Ali et al., 2013; Sale et al., 2004). Similar benefits are expected in the context of sports nutrition and performance optimisation. This study concludes that a dietitian's website is an effective tool for diagnosing patients and providing information about the causes, treatment, prevention, control, and procedures related to their health status. This approach could help reduce the national death rate by allowing

individuals to assess their health online without needing a doctor's consultation.

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