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Ministry of higher Education and Scientific research

Emirates International University

College of Engineering

Portable Dental Unit

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A graduation project report submitted to the department of. Engineering in partial fulfillment of the requirements of bachelor degree in biomedical engineering

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Summary

The Portable Dental Medical Unit is an independent, compact medical system used provide dental care outside of traditional clinics. It consists of a compressed ai system, suction system, and a variety of dental medical tools. This unit operates on a 12- volt system and that is In addition, the Portable Dental Medical Unit operates on an electrical system, but also that functions on battery power, enabling its use in areas without reliable electricity access. That These portable dental units are utilized in underserved communities, emergency situations and The Portable Dental Medical Unit is an independent, compact medical system used to provide dental care outside of traditional clinics. It consists of a compressed air system, and suction system, and a variety of dental medical tools. This unit operates on a 12-volt system and it's a The Portable Dental Medical Device is an advanced medical tool designed to provide dental services in remote areas or regions suffering from a lack of medical facilities. The key features-Its ability to operate using electricity or battery power, making it versatile for use in diverse locations Its incorporation of a comprehensive set of equipment and devices required to perform the majority of basic dental Its capacity to deliver routine and emergency dental examinations and treatments directly in areas lacking traditional medical facilities and that is Its independence from stationary power sources, enabling its use in remote and rural areas an Owing to these characteristics, the Portable Dental Medical Device is an effective instrument for expanding the reach of dental services to underserved communities.

Authorization

We authorize university emirates of faculty of engineering to supply copies of our graduation project report to libraries, organizations or individuals on request. The faculty, also authorized to use it in local or international competitions.

Student Name	Signature	Date

Dedication

I dedicate this work to my parents, whose endless love, support, and encouragement have been the foundation of my success. Their belief in me has given me the strength to persevere through every challenge.

To my family, friends, and mentors, who have offered invaluable guidance and motivation throughout this journey, thank you for your unwavering support.

This research is also dedicated to all those who face adversity with courage, especially stroke survivors. It is my hope that this project will contribute to their recovery and improve their quality of life.

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Acknowledgment

Before and above all, we would like to record our endless thanks to **Allah** for everything he gives us.

We wish to express our deepest gratitude and appreciation to **Dr**.**mohammed Al-alfi** for excellent guidance, kind encouragement, scientific advice, helpful supervision and good wishes instilled the strength in us to make this work possible. Last but not least, we owe a great deal of gratitude, thanks and appreciation to all members of our families, for their kind support, help and encouragement.

Supervisor Certification

I certify that the preparation of this project entitled

Portable Dental Unit,

prepared by ……

……..

was mad under my supervision at **Engineering** department in partial fulfillment of the requirements of bachelor degree in **Biomedical Engineering**

Supervisor Name

Signature

Date

Examiner Committee

Project Title: Portable Dental Unit

Supervisor

No	Name	Position	Signature
1			

Examiner Committee

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Department Head

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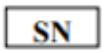	Serial Number	O	OFF
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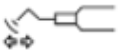
	Handpiece		Scaler switch
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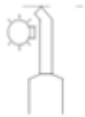	LED Curing Light		This symbol indicates that this product is not to be disposed with your residential or commercial waste.

1 Chapter 1: Introduction

1.1 Overview

The Portable Dental Unit is a small, mobile unit that contains the essential medical equipment and tools necessary to provide basic dental healthcare services at various locations outside of traditional dental clinics. This modern and practical technology is used in the field of dentistry to meet treatment needs in areas where access to a fixed dental unit may be difficult or impossible. Rather than relying on stationary clinics and their rigid setups, dentists and medical teams can transport the Portable Dental Unit and deliver fundamental health services to patients at diverse sites. The Portable Dental Unit provides a comprehensive set of components in a portable case, including a water delivery and suction unit, as well as a compressed air unit. Additionally, it can be equipped with an amalgam mixer and a control panel. These integrated and organized components allow medical teams to perform basic treatments such as cleaning, fillings, and restorations in non-traditional locations. The Portable Dental Unit is particularly useful in cases of mobility, such as home visits for patients with limited mobility, in remote communities with restricted access to healthcare services, and in temporary medical facilities like field hospitals and refugee camps. By improving accessibility to basic healthcare, the Portable Dental Unit enhances the ability of individuals in communities facing challenges in accessing traditional healthcare services to receive the necessary treatment. It also enhances patient comfort and provides them with the required care in a convenient and flexible manner. Additionally, the Portable Dental Unit can be powered by batteries in areas without electricity, which is a significant advantage, allowing it to operate using both electrical and battery power systems Furthermore, the Portable Dental Unit can leverage the growing dental workforce to enhance oral health through the provision of mobile dental services.[1]

1.2 Project problems:

1. **Difficulty in Accessing Patients in Remote and Restricted Areas:**
   - Patients who may face challenges in reaching traditional clinics (e.g., elderly, individuals with special needs, those living in distant locations).[2]

2. **Lack of Adherence and Continuity in Treatment:**
   - Patients failing to attend regular visits and complete treatment plans.
   - This impacts the outcomes of oral healthcare provided to patients.[2]

3. **Burden of Travel and Costs:**
   - Expenses associated with transportation and missed work to attend in-person appointments.[2]

4. **Limited Expansion of Services:**
   - Services being confined to specific geographic regions.[2]

5. **High Establishment and Operational Costs:**
   - Expenses related to construction, design, rent, and other factors.[2]

❖ **The Solution:**
The Portable Dental Unit

The portable dental unit provides innovative solutions to the key challenges faced by traditional dental clinics, making it a valuable tool in improving access to dental healthcare and enhancing their competitive capabilities**.**

Difficulties

- 1-Difficult to find a suitable compressor of the size and amount of air now appropriate
- 2-Difficulty in providing suitable valves in the local market Controllers open and close dental hand pieces.
- 3-The tools of project are high cost.

1.3 Project Objectives

The main objectives of this project may be summarized in the following:

- Assisting individuals with special needs who are unable to visit a dental clinic
- Assisting dental students in their applications.
- Assisting residents in villages and remote areas.
- Awareness.
- "Your Teeth Are the Mirror of Your Health".
- Diverse marketing opportunities.
- Improve patient experience.
- Cost-effective solution.
- Easy to transport and save time and space.
- Easily Move Your Clinic: You can easily move your clinic from one room to another.
- Easy Control and Repetition.
- Easy Maintenance.
- Assistance in Rural Areas and for Physically Disabled Individuals.
- Ease of Transport with the Device for Field Trips.
- All Optional Tools Can Operate Efficiently in Continuous Use, such as Micro motors, Turbines, and Air Cleaners.

1.4 Project Scope and Limitations

Project Scope:

Provision of Basic Dental Services: This includes dental examinations, diagnosis of oral problems, treatment of decay, general cleaning, temporary fillings, and restorations.

Specification of Equipment and Tools Included in the Portable Dental Unit**: Such as the treatment chair, cleaning instruments, filling materials, and, if available, portable X-ray equipment.

Identification of Services Provided by the Portable Dental Unit: Such as cleanings, fillings, and temporary restorations.

Targeted Communities or Areas: Identifying the remote areas, schools, or healthcare institutions that will benefit from the portable dental unit.

Project Implementation Timeline: Determining the expected duration for providing services at each location.

Health Education and Awareness: Conducting seminars and lectures on the importance of oral and dental health care, and how to prevent decay and gum diseases.

Coordination with Local Authorities: Collaborating with local health authorities and educational institutions to ensure effective outreach to target communities and provide necessary support.

Evaluation and Follow-Up: Preparing periodic reports to assess the effectiveness of the services provided and identify areas for improvement or development.

Limited Equipment: The portable dental unit may have limitations in terms of the available equipment compared to traditional dental clinics, which may restrict certain procedures that cannot be performed using this unit.

Technical Challenges: The technical team may face challenges in providing electricity and communication in remote locations, which can affect the ability to deliver services effectively.

Space Limitations: Due to the portable and compact nature of the dental unit, there may be constraints on the available space for providing treatments and storing equipment and materials.

Safety Precautions: Adequate infrastructure and safety measures should be taken to ensure the safety of patients and the dental team, and to comply with health and safety standards while using the portable dental unit.

Logistical Challenges: Transporting equipment and materials to remote locations may require careful planning to ensure all necessary resources are available in a timely manner.

Human Resources: Ensuring the availability of a sufficient number of well-trained doctors and assistants to provide services efficiently and with high quality.

Funding and Budget: Securing adequate funding to cover all project costs, including equipment, transportation, and human resources, with planning for emergency expenses.

1.5 **Project methodology**

The methodology for developing the mobile dental unit project is as follows:

Main Objective: The project aims to develop a mobile dental unit to provide dental care services in underserved and remote areas with limited healthcare facilities. The primary goal is to improve access to oral healthcare for disadvantaged populations.

Analytical Study: A comprehensive analysis was conducted to review existing mobile medical units available in the market. It was observed that these units lacked the necessary equipment compared to traditional dental clinics. Furthermore, input and feedback from dental professionals were sought during the development process to ensure the unit meets the required standards.

Design and Planning: A sequential work plan was formulated to guide the implementation of the project. This plan includes the addition of essential components that are lacking in current mobile medical units. A specific timeline was established to ensure the timely completion of each phase of the development process.

Implementation and Monitoring: The mobile dental unit is implemented with regular monitoring and evaluation carried out by specialized engineers. This is done to ensure the efficiency and accuracy of the unit's operations. The entire process adheres to recognized academic standards and healthcare guidelines to ensure the delivery of high-quality dental care services.

Expected Results: The implementation of the mobile dental unit is anticipated to enhance access to oral healthcare in underserved areas and communities with limited medical resources and healthcare centers. The unit will provide dental care services to remote areas and vulnerable communities facing difficulties in accessing medical services

1.6 **Report Organization:**

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- ✓ Difficult

- ✓ Project Objectives
- ✓ Project Scope and Limitations
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2 Chapter 2: Background and Literature Review

2.1 Introduction

Mobile dentistry is a concept aimed at providing dental services to individuals in locations where access to healthcare is challenging. This includes remote areas, rural communities, schools, mobile health clinics, social centers, and camps. The goal of mobile dental units is to provide basic and preventive dental and oral care to people who have difficulty accessing traditional dental treatment Mobile dental units rely on portable equipment and small, transportable setups to enable healthcare teams to deliver care in various locations. These setups may include a water and suction delivery unit, compressed air unit, as well as basic treatment tools such as cleaning and filling instruments. The specific equipment used depends on the needs and capabilities of the mobile dental unit. Mobile dentistry is important for individuals who face barriers in accessing healthcare due to long distances, financial constraints, or other limitations. It contributes to improving access to oral healthcare, enhancing overall health, However, it is important to note that mobile dentistry also faces limitations and challenges. The available equipment in mobile units may be limited compared to traditional dental. Despite these limitations, mobile dentistry represents an important advancement in healthcare delivery. Globally, numerous non-governmental organizations and healthcare institutions are implementing mobile dentistry programs in areas of need. Collaboration between governments, healthcare institutions. [3]

2.2 Literature Review

Examining the development of dental clinics throughout history reveals significant improvements over time. In ancient times, dental services were limited and primarily consisted of extracting diseased teeth. The concept of the dental chair dates back to the 18th century when French dentist Nicolas Dubois de Chemant designed a prototype dental

chair in 1807. This model consisted of a simple wooden chair with limited functionality. Over time, dental chair designs evolved and their functions improved. The First Half of the 20th Century - :In 1958, Dr. George F. Griner developed a portable dental unit connected to an external compressed air source - .In 1972, Dr. Karl Heinz Gilard developed a portable dental unit powered by an external electrical source. This design was smaller and lighter than compressed air units - .In 1987, Dr. Gerald Mandel invented a fully electrically powered portable dental unit. This design was even more compact and lightweight compared to previous systems, making it. [4]

Figure 2.2-1 dental chair in 1807

2.3 Overview of Teeth

2.3.1 Introduction

Each jaw contains 10 deciduous (baby) teeth that are later replaced by the permanent teeth. This tooth replacement process begins around 5-6 years of age and continues until around 14 years of age. The full set of permanent teeth numbers 18 per jaw, plus the wisdom teeth (third molars), which are the third set of molars that erupt between ages 17-24, resulting in a total of 32 permanent teeth. Specifically, each half of the jaw contains 4 incisors, 2 canines, 4. [5]

2.3.2 The components of the tooth

Enamel - the hard, outer protective layer covering the crown of the tooth above the gum line. Enamel is insensitive to pain. Dentin - the inner, sensitive layer of the tooth, composed of millions of small tubules. Dentin is harder than bone but more sensitive to temperature and touch. Cementum - the layer covering the root of the tooth below the gum line, instead of enamel. Pulp - the central core of the tooth containing blood vessels and nerves that nourish the tooth. The root of the tooth is anchored into the jawbone by the periodontal ligaments, which allow the tooth to withstand the forces of chewing and act as a shock absorber between the tooth and the bone socket (alveolus) that houses the tooth root. [5]

The stages of dental caries:

The stages of dental caries can be summarized as follows:

1. Bacterial Presence: Bacteria are present in the mouth, just as they are in any other part of the human body. These bacteria can convert certain types of sugars and carbohydrates consumed by the individual into a type of acid.
2. Plaque Formation: The acids produced by the bacteria, along with the bacteria themselves, form a mucous film known as the "dental plaque" or "bacterial plaque." This plaque has the ability to adhere to the teeth.
3. Enamel Demineralization: The acidic environment created by the plaque begins to demineralize the tooth enamel, the hard outer layer of the tooth.
4. Cavity Formation: As the demineralization process continues, a small hole or cavity can form in the enamel. This is the initial stage of dental caries or tooth decay.
5. Dentin Penetration: If left untreated, the cavity can progress and penetrate the dentin, the layer of the tooth beneath the enamel [5]

The hardness of natural teeth and the materials that make up them: Enamel is the hardest part of the human body and the most mineralized (contains a very high mineral content.). And in addition to dentin, pulp and nurture forms the our main tissues forming teeth in vertebrates. Enatnel is the superficial part of the tooth that we always see when we watch people talk or smile, so ivory plays an important role in supporting and protecting the enamel. Minerals make up 96% of the enamel. while water to locales and organic tatter make up the rest. The natural color of the dial is white to yellowish. which bacons more pronounced with The reason for the appearance of yellow color is due to the transparency of the enamel, The thickness of the enamel at the camshaft of the teeth is very large (2.5 mm) compared to the thickness at the point of contact between the enamel and mortar. The main metal involved in the cot position of the Enatnel is hydroxyl apatite. and this particular

mineral and its high quality is responsible for the strength and fragility of the enamel. Retiming to the Moss scale of hardness of materials, we find that the enamel is ranked fifth in terms of strength, while ivory occupies the classification between the third and fourth and this provides sufficient support to protect the enamel. [5]

2.4 Power used to drill teeth

A dental drill or headpiece is a hand-held, mechanical instrument used to perform a variety of common dental procedures, including removing decay, polishing fillings, and altering prostheses. The hand piece itself consists of internal mechanical components, which initiate a rotational force and provide power to the cutting instrument, usually a dental burr. The type of apparatus used clinically will vary depending on the required function dictated by the dental procedure. It is common for a light source and cooling water-spray system to also be incorporated into certain hand pieces; this improves visibility, accuracy and overall success of the 4.5 Mouth Anatomy (Human) In human anatomy. the 111011th is the first portion of' the alimentary canal that receives rood and produces saliva. The oral tnucosa is the IIIUCOUS membrane epithelium lining the inside of the mouth. In addition to its plenary role as the beginning of the digestive system, in humans the mouth also plays a significant role in communication. While primary aspects of the voice ate produced in the throat. the tongue. lips. and jaw are also needed to produce the range of sounds included in human language. The 111011th consists of two regions. the vestibule and the oral cavity pumper. The 111011th. normally Insist. is lined with a nucleus membrane. [5]

2.5 Oral Cavity

The mouth, consists of 2 regions, the vestibule and the oral cavity proper. The vestibule is the area between the teeth. lips and cheeks. The oral cavity is bounded at the sides and in front by the alveolar process (containing the teeth) and at the back by the isthmus or the faces. I-lard palate at the front. and a soft palate at the back form its roof. The uvula projects downwards from The middle of the son palate at its back. The floor is frothed by the thyrohyoid muscles and is occupied mainly by the tongue. A mucous membrane the oral

mucosa, lines the sides and under surface of the tongue to the gums, linin cy the inner aspect of the jaw (mandible). It receives the secretions from the submandibular and sublingual salivary glands [5]

2.6 **Human Teeth**

Teeth: are among the most distinctive (and long-lasting) features of' mammal species. Humans. like other mammals, are ziphodont, leaning that they develop two sets of teeth. The first set (called the "baby", "milk". "prituarytt, or "deciduous" set) normally starts to appear at about six months of age, although some babies are born with one or more visible teeth, known as natal teeth. Normal tooth eruption at about six months is known as teething and can be painful. [5]

2.6.1 **Human Teeth Anatomy**

Human Teeth Anatomy: The anatomic crown of a tooth is the area covered in enamel above the cement enamel junction (CEJ) or "neck" of the Most of the crown is composed of dentin ("dentine" in British English) with the pulp chamber inside. [31 The crown is within bone before eruption. [41 After eruption, it is almost always visible. The anatomic root is found 'below the CEJ and is covered with cementum. As with the crown, dentin composes most of the root.

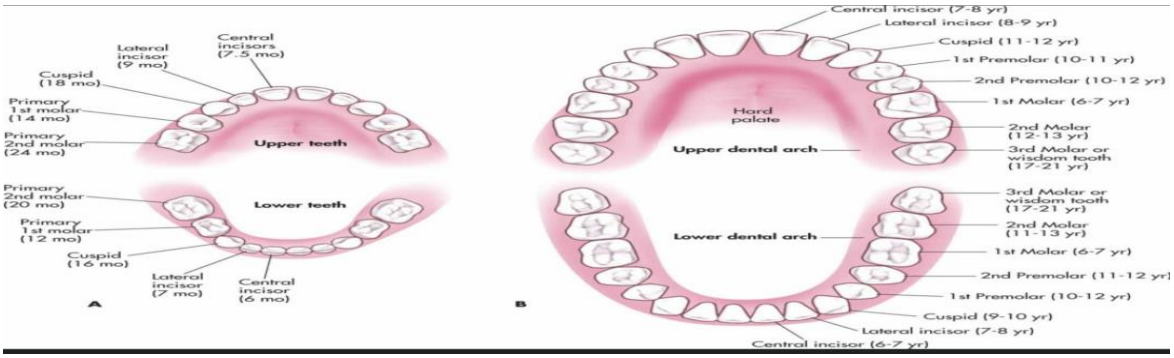

Figure 2.6-1 Human Teeth Anatomy

Hardness of Teeth and Materials that consist them

Enamel's primary mineral is hydroxyapatite, which is a crystalline calcium phosphate. [1] The large amount of minerals in enamel accounts not only for its strength but also for its brittleness.[9] Dentin. which is less mineralized and less brittle, compensates for enamel and is necessary as a support. [11] Unlike dentin and bone, enamel does not contain collagen. Proteins of note in the development of enamel are ameloblastins, amelogenins, enamelins and tuftelins. It is believed that they aid in the development of enamel by serving as framework support, among other functions.[12] In rare circumstances enamel can fail to form, leaving the underlying dentine exposed[5]

Enamel

Enamel is the hardest and most highly mineralized substance of the body. It is one of the four major tissues which make up the tooth, along with dentin, cementum, and dental pulp. [71 It is normally visible and must be supported by underlying dentin. 96% of enamel consists of mineral, with water and organic material comprising the rest. [8] The normal color or enamel varies from light yellow to grayish white. At the edges or teeth where there is no dentin underlying the enamel, the color sometimes has a slightly blue tone. Since enamel is semi translucent, the color of dentin and any restorative dental material underneath the enamel strongly affects the appearance of a tooth. Enamel varies in thickness over the surface of the tooth and is often thickest at the cusp, up to 2.5mm, and thinnest at its border, which is seen clinically as the CEJ .[9J The wear rate of enamel, called attrition, is 8 micrometers a year from normal[5]

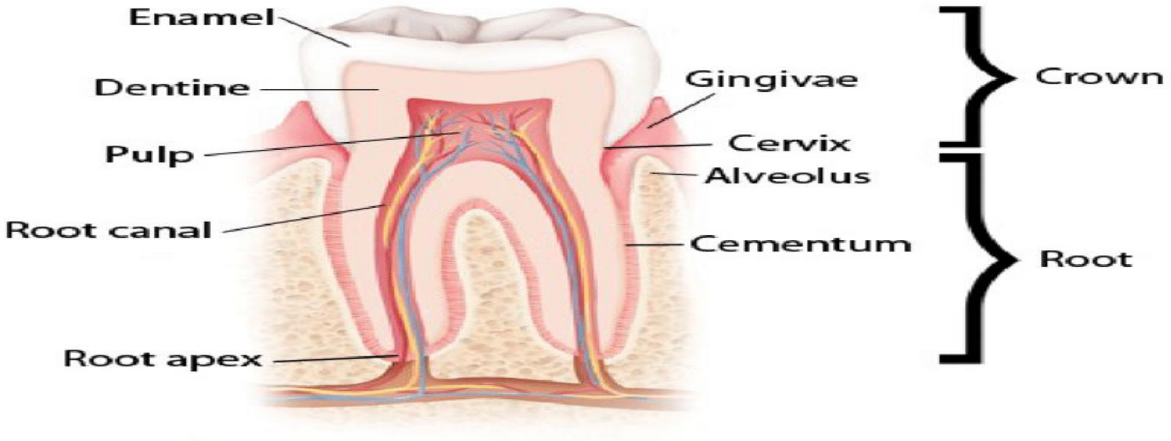

Figure 2.6-2 Enamel

Dentin

the odontoblasts of the dental pulp.[6] The Ibrmation ol' dentin is known as dentin genesis. The porous, yellow-hued material is made up or 70% inorganic Inalerials, 20% organic materials, and 10% water by weight.[7] Because it is softer than enamel, it decays toner rapidly and is subject to severe cavities if not properly treated, but dentin still acts as a protective layer and supports the crown of the tooth. Dentin is a mineral used connective tissue with an organic Inatrix or collagenous proteins, Dentin has microscopic channels. called dentinal tubules, which radiate outward through the dentin from the pulp cavity to the exterior cementum or enamel border.1161 The diameter or these tubules range from 2.5 pm near the pulp, to 1.2 pm in the midportion, and 900 nm near the dentinoenamel junction. [7] Although they may have tiny side-branches, the tubules do not intersect with each other. Their length is dictated by the radius of the tooth. The three dimensional configuration or the dentinal tubules is genetically determined. There are three types of dentin, primary, secondary and 181 Secondary dentins are a layer of dentin produced after root formation and continues to forni with age. Tertiary dentin is created in response to stimulus. such as cavities and tooth wear[5]

2.6.2 Cementum

Cementum is a specialized bone like substance covering the root of a tooth.[8] It is approximately 45% inorganic material (mainly hydroxyapatite), 33% organic material (mainly collagen) and 22% water. Cementum is excreted by cementoblasts within the root of the tooth and is thickest at the root apex. Its coloration is yellowish and it is softer than dentin and enamel. The principal role of cementum is to serve as a medium by which the periodontal ligaments can attach to the tooth for stability. At the cement to enamel junction, the cementum is acellular due to its lack of cellular components, and this acellular type covers at least % of the root. [9] The more permeable form of cementum, cellular cementum, covers about % of the root apex. [6]

Dental pulp

The dental pulp is the central part of the tooth filled with soft connective tissue.[7] This tissue contains blood vessels and nerves that enter the tooth from a hole at the apex of the root.[10]Along the border between the dentin and the pulp are odontoblasts, which initiate the formation of dentin.[11] Other cells in the pulp include fibroblasts, preodontoblasts, macrophages and T lymphocytes.[4] The pulp is commonly called "the nerve" [6]

2.7 Teeth drill and various sizes of drill burrs

A dental drill or hand piece is a hand-held, mechanical instrument used to perform a variety of common dental procedures, including removing decay, polishing fillings, and altering prostheses. The hand piece itself consists of internal mechanical components which initiate a rotational force and provide power to the cutting instrument, usually a dental [6]

Dental and oral care

The areas of dentistry and dental care are not limited to teeth and gums, but you can add health care to the muscles of the head, neck, jaw, tongue, salivary glands. nervous system or the head, neck and other areas. When a comprehensive examination by dentists; In addition, they arc also looking for lumps and swelling. and cases of' gum discoloration, ulcers, etc., and when needed they Inlay perform procedures such as taking biopsies and other specialized diagnostic tests, to detect chronic or infectious diseases, and detect and examine the functions of the salivary glands, In addition to testing for oral cancer. [6]

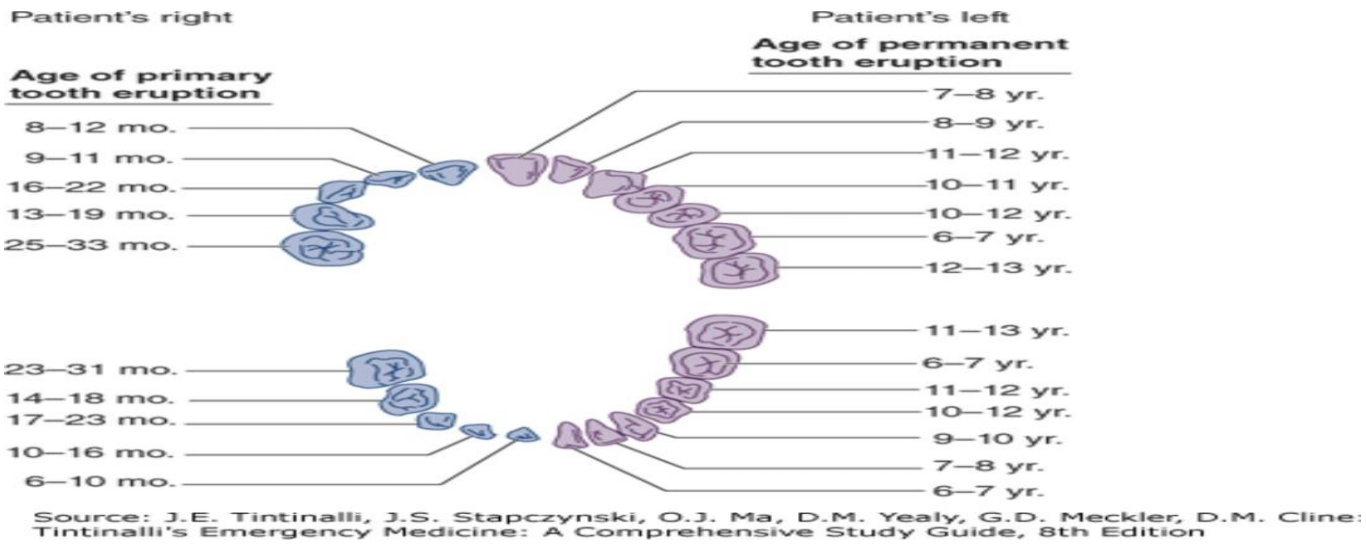

Figure 2.7-1 Dental and oral care

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Tapes of teeth and functions

l) Incisors: The front teeth are located in the front of the mouth and number 8 in coach jaw 4

Function: Used for cutting food into small pieces.

2) Fangs: number 4 in each jaw Naban on both sides of the front teeth are conical. Function: Used for tearing food and auxiliary cutters.
3) Front molars: are on both sides of the fangs and number 8 in each jaw 4 premolars. Function: grind food and chew. [6]
4) Rear molars: are larger than the front molars and are located on both sides of premolars and the number of 12 molars in each jaw 6 molars on each side 3 and the crown is a chewing surface.

Human Teeth type

Among deciduous (primary) teeth, ten ate found in the Inaxilla (upper ji^{v}e) and ten in the mandible (lower jaw), for a total of 20. The dental fonnula for primary teeth in humans. In the primary set of teeth, there are two types of incisors — centrals and laterals— and two types of molars — first and second. All primary teeth are nonnally later replaced with their permanent [6]

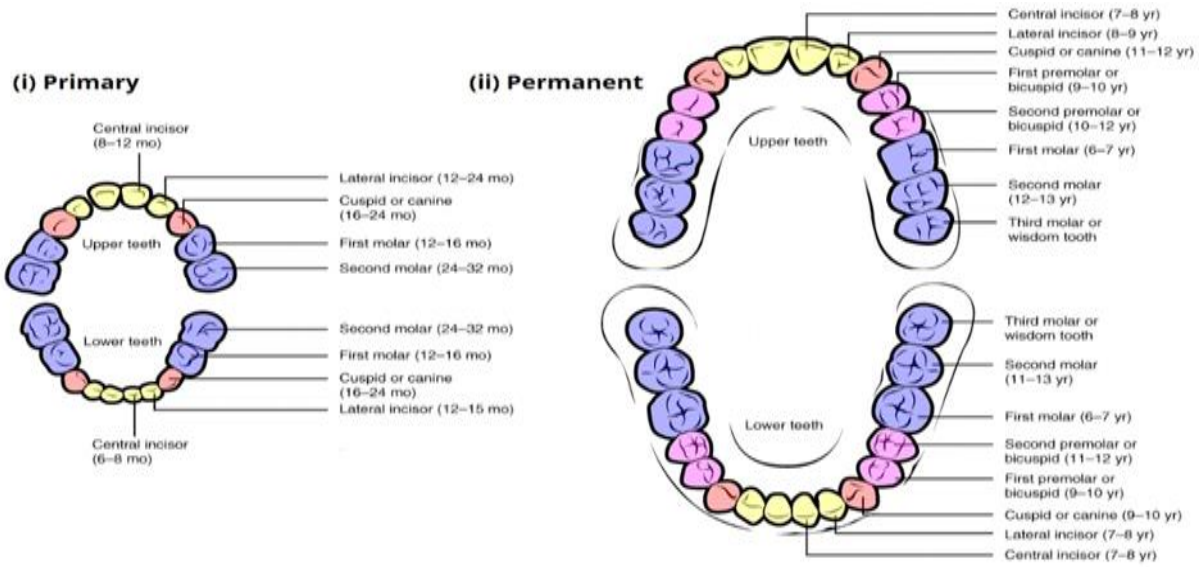

Figure 2.7-2 Primary teeth

Permanent teeth

Among permanent teeth, 16 are found in the maxilla and 16 in the mandible, for a total or 32. The dental formula. The maxillary teeth are the Inaxilla central incisor, maxillary lateral incisor, maxillary canine, maxillary first premolar, maxillary second premolar. maxillary first molar, maxillary second molar, and maxillary third molar. The mandibular teeth are the mandibular central incisor, mandibular lateral incisor, Inandibular canine. mandibular first premolar, mandibular second premolar, mandibular first molar. mandibular second molar, and mandibular third molar. Third molars are commonly called "wisd011) teeth" and may never erupt into the mouth or form at all. If any additional teeth Conjuror example, fourth and fifth molars, which are rare. they are referred to as supernutnerary teeth (hypertonia). (51 Development of fewer than the usual number ol' teeth is called hypodontia. There are small differences between the teeth of males and females, with male teeth along with the male jaw tending to be larger on average than female teeth/ jaw. There are also differences in the internal dental tissue proportions, with male teeth consisting of proportionately more dentine while female teeth have proportionately more enamel [6]

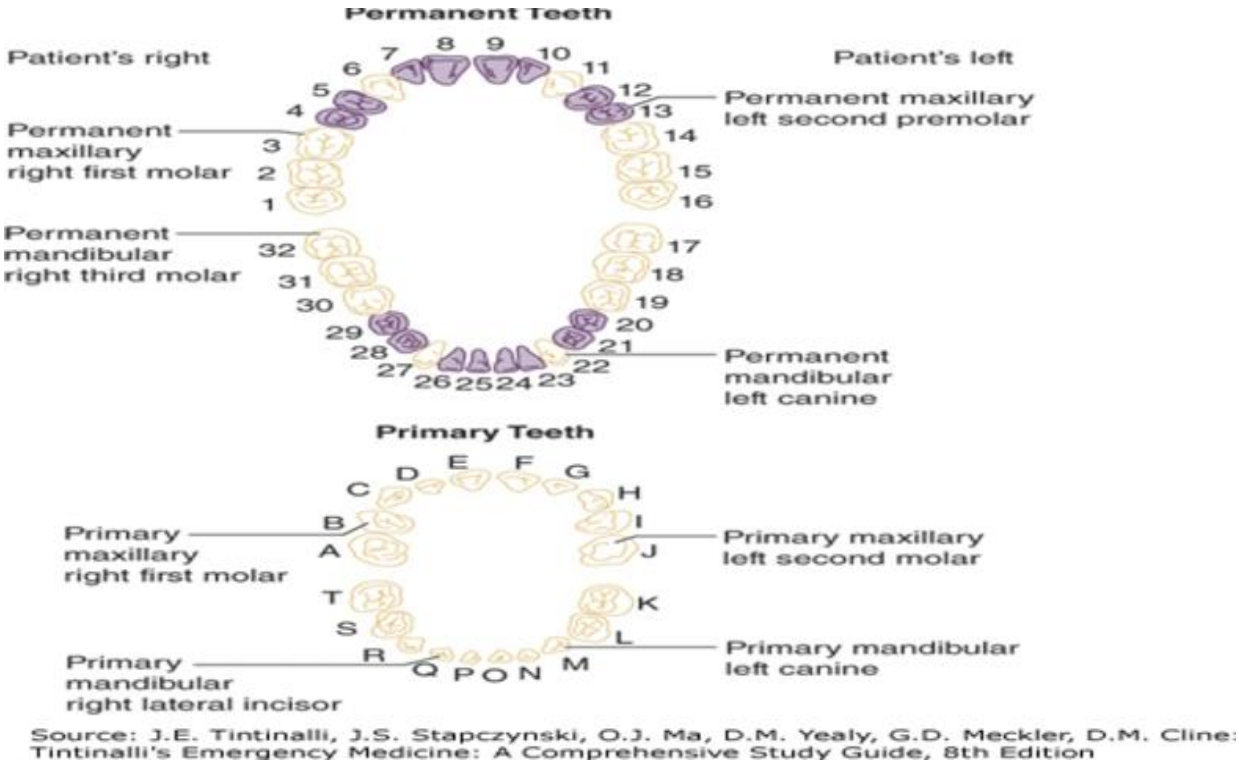

Figure 2.7-3 Permanent teeth

2.8 **Medical part about teeth and jaw**

Dentistry: It is a branch of Inedicine, specializes in the study, diagnosis and treatment of diseases of the mouth, face, jaw, teeth and surrounding tissues and their prevention and branches into Inany disciplines. The practitioner is called a dentist. Although dental is primarily tiled to the mind of the general public, its scope is not limited to it, but includes other aspects of the cranial facial complex, including the temporomandibular structures and other supporting structures. The containment of dentistry is often understood to be a largely obsolete medical specialty, oral medicine (oral study, disorders and diseases). Dental treatments are performed by a dental team consisting mostly of a dentist and dental assistants, including a dental assistant, a dental hygienist, a dental technician, and a dental therapist. Most dentists practice in private clinics (primary health care clinics) [8]

2.9 Types of Dental

2.9.1 Dental treatment

Dental treatment: is intended to repair and restore parts of the tooth that are lost due to decay or breakage. Teeth are 'usually restored with amalgam (an amalgam filler), an alloy consisting mainly of silver and mercury, mistakenly called platinum. The posterior teeth are usually repaired with amalgam filling as they are more able to withstand great stress as a result of chewing food. The front teeth are restored with a light filler that is as close to the color of the tooth, making it more aesthetic. New generations of photovoltaic fillings have been manufactured to withstand great stresses and are now used for both back and front teeth. [8]

2.9.2 Maxillofacial surgery, facial

Maxillofacial surgery, facial: The specialty of oral surgery is one or the specialties of dentistry and includes several subspecialties. including: Tooth extraction and minilnally invasive oral surgery such as wisdom tooth extraction surgery embedded under the bone. Treatment of racial fractures resulting from accidents and other injuries. Treatment or infections caused by dental problems such as facial swelling due to abscess formation. Treatinent of cysts, tumors and salivary gland tumors in the area of the mouth, face and jaws. Orthopedic Surgery Orthopedic surgery is a surgical adjustment of the jaw with both traditional methods and bone lengthening. Treatment of congenital malformations of the maxillofacial region such as cleft lip and throat roof deformities. Bone and dental implants. Maxillofacial surgery. Reconstructive surgery to compensate for missing tissues in the mouth, face and jaws[8]

2.9.3 Diseases of the tissues that surround the teeth, Gum disease

Diseases of the tissues that surround the teeth, Gum disease: Gingivitis is the most common and mild disease of periodontal disease (periodontal disease) and causes irritation, redness and swelling (inflammation) of the gums, the part surrounding the roots of your teeth from your gums. It is important to take gingivitis seriously and treat it without delay. Gingivitis may lead to another more serious gingival disease called periodontitis and tooth loss. The most common cause of gingivitis is a lack of attention to oral hygiene. Healthy

oral hygiene habits. such as brushing teeth at least twice a day, using dental floss daily and periodically checking teeth, can help prevent and reverse the effects of gingivitis. [8]

2.9.4 Orthodontics

Orthodontics: It is a field of dentistry that is concerned with the study and treatment of defects of occlusal problems and jaw problems (malocclusion), which may be due to irregular teeth, disproportionate jaw relationships (between the upper and lower jaws), or [8]

2.9.5 Preventive Medicine

Preventive Medicine: Preventive medicine belongs to the branch of community medicine. Preventive medicine is one of the basic branches of medicine that aims to anticipate and prevent diseases before they occur. [8]

2.9.6 Anatomy of the teeth

Anatomy of the teeth: A branch of dentistry specializing in the study or the structure and shape of human teeth - visible with the naked eye - and their emergence and emergency in the Dental implant: Dental implants are currently the biggest development or dentistry as they treat tooth loss without the need to involve any or the teeth being lost. Dental implants have a good success rate and depend on good bone cooling during work, sterilization of the area, mastering the implant position and the axis of' intertwining with the corresponding teeth. Dental material: They are special synthetic materials, fabricated and specially made for use in dentistry. There are various types whose characteristics vary according to the purpose. [7]

2.9.7 Prosthodontics include

Prosthodontics include: Prostheses and temporary fillings, Restorative dental materials (permanent fillings, crowns, bridges), Tools and materials used to treat dental roots, Materials 'used in dentures, Materials used in the manufacture of dentures and Prosthodontics, Dental implants, And many more. [7]

2.9.8 Dental rays

Dental rays: It is one of the most important diagnostic methods in dentistry and is represented in more than one type there are simple rays and panoramic rays, which will identify them through the following lines and the benefits of panoramic radiography: Simple rays, which can shoot two or three years, and does not include large areas around the area depicted, and there is a modern type of these devices connected to the computer, where you can shoot with higher accuracy and the amount of less radiation in addition to speed as the image appears directly on the computer without the need to Waiting for film development. Panoramic rays can include imaging of the teeth of the jaws in one image, as well as the maxillary joint, sinuses and fundus of the eye, which is very necessary in some cases. In most advanced clinics, panoramic radiographs are an axiom that must be adhered to prior to dental treatment. As we all know, diagnosis is the most important stage of treatment. [7]

2.9.9 Cosmetic Dentistry

Cosmetic Dentistry: This section takes care of teeth both aesthetically and functionally. This section of dental science is an important branch or interest to many individuals. especially those who must show people with beautiful and attractive appearances. or even anyone else who cares about his look and seeks a beautiful race and bright teeth. [7]

2.9.10 Dental Interests

Dentistry and oral health sciences are generally concerned with the study and analysis of dental. gum and oral health. diseases and problems. The primary goal of this important science is to prevent complications. such as tooth decay. Gum disease. [7]

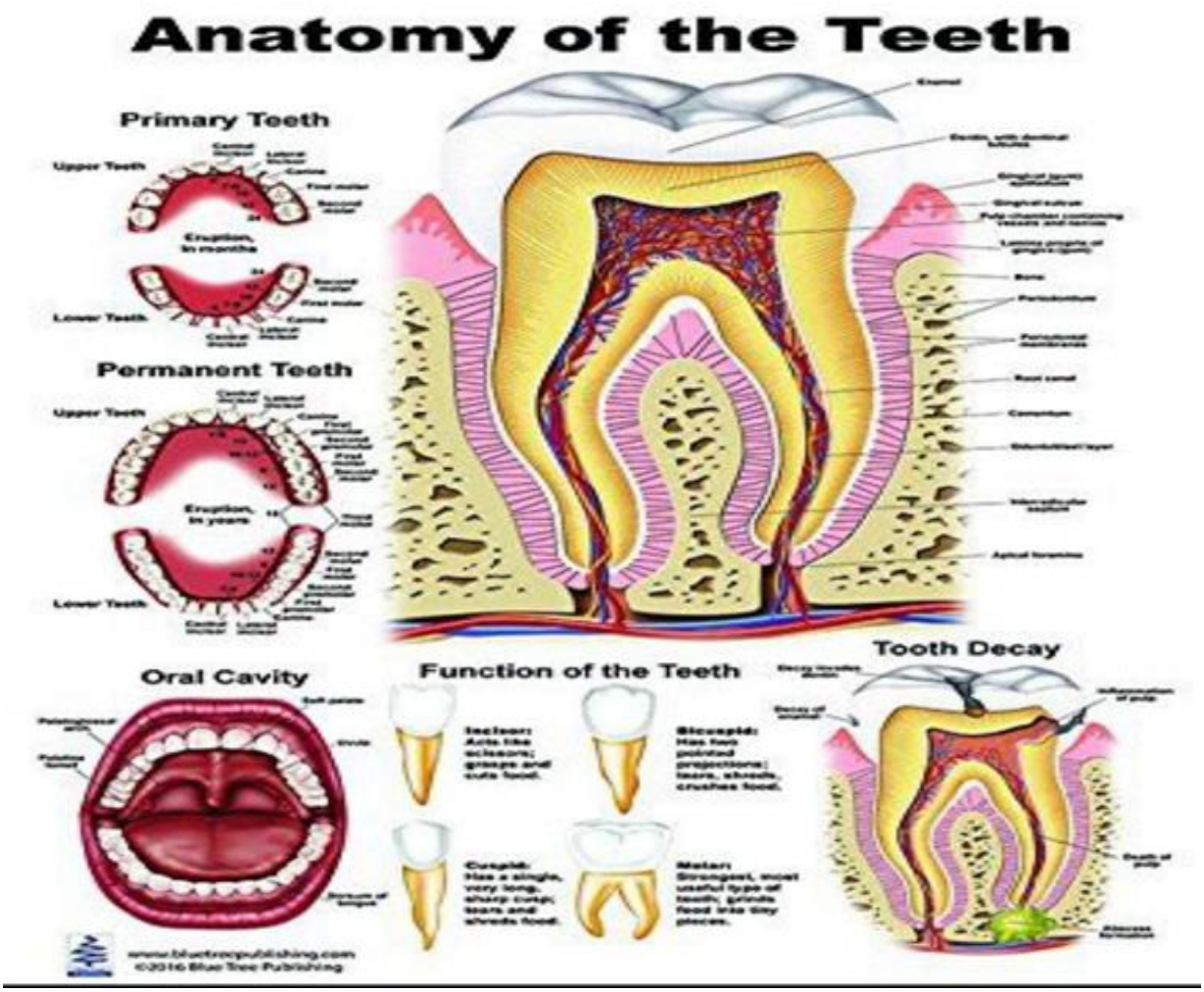

Figure 2.9-1 Anatomy of the teeth

3 Chapter 3: Requirements Analysis and Modeling

3.1 Introduction

The project aims to develop a portable dental unit to meet the needs of patients in remote villages and areas, and people with special needs, by developing a portable dental unit.

3.2 User Requirements

project is focused on patients who are unable to visit a traditional dental clinic, such as those with special needs or burn victims. The goal is to provide them with dental care and services.

3.3 Project Block Diagram

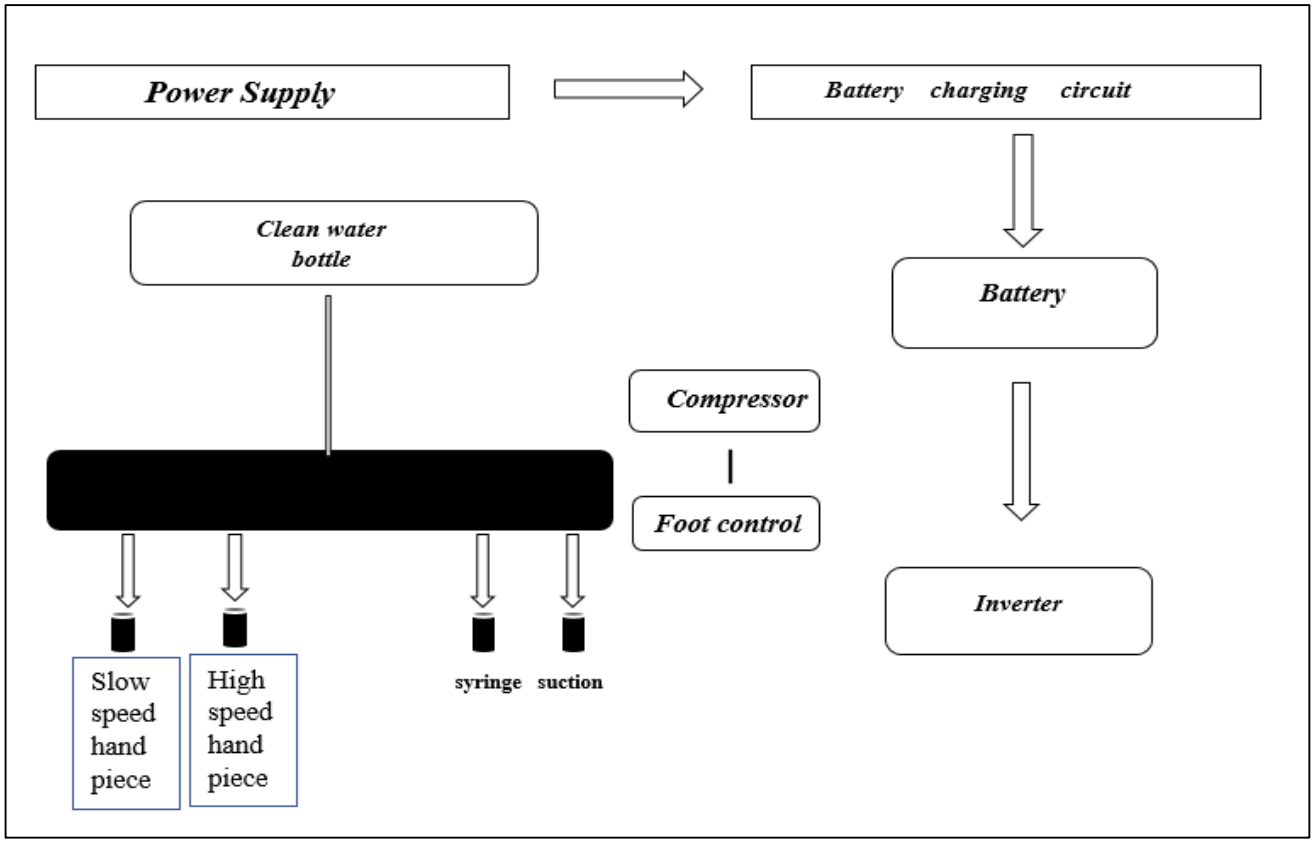

Figure 3.3-1 Block Diagram

3.4 System Requirements

- Field Devices

1. Air Compressor.
2. Battery.
3. Suction.
4. High speed turbine.
5. Slow Motion Hand Piece.
6. 3 Way Syringe.
7. Air Bottle.
8. Valves.
9. Foot pedal.
10. Waste Bottle.
11. Water Bottle.
12. Automatic Switch
13. Fan.

Figure 3.4-1 Basic Examination

3.5 Performance Requirement

- Mobility: The unit must be highly portable and easily transported to remote locations and patients' homes. It should have a compact, lightweight design with wheels or other mechanisms to facilitate mobility.
- Power Efficiency: The unit should be able to operate efficiently on battery power or easily adaptable to different power sources, including off-grid locations with limited infrastructure.
- Comprehensive Functionality: The unit should provide a full range of essential dental services, including examination, cleaning, minor procedures, and basic treatments. It should be equipped with the necessary dental instruments, tools, and equipment.
- Ease of Use: The design should prioritize simplicity and user-friendliness, allowing healthcare providers to set up and operate the unit with minimal training.
- Infection Control: The unit must have robust infection control measures, such as sterilization capabilities, to maintain high standards of hygiene and patient safety.
- Durability: The unit should be rugged and able to withstand the challenges of transportation and use in diverse environments, including remote and resource-limited settings.
- Affordability: The cost of the portable dental unit should be reasonable and accessible, particularly for deployment in underserved communities and regions.
- Adaptability: The unit should be versatile and able to accommodate the unique needs and infrastructure of different locations, including the ability to interface with local healthcare systems and facilities. [6]

3.6 **Flow Chart**

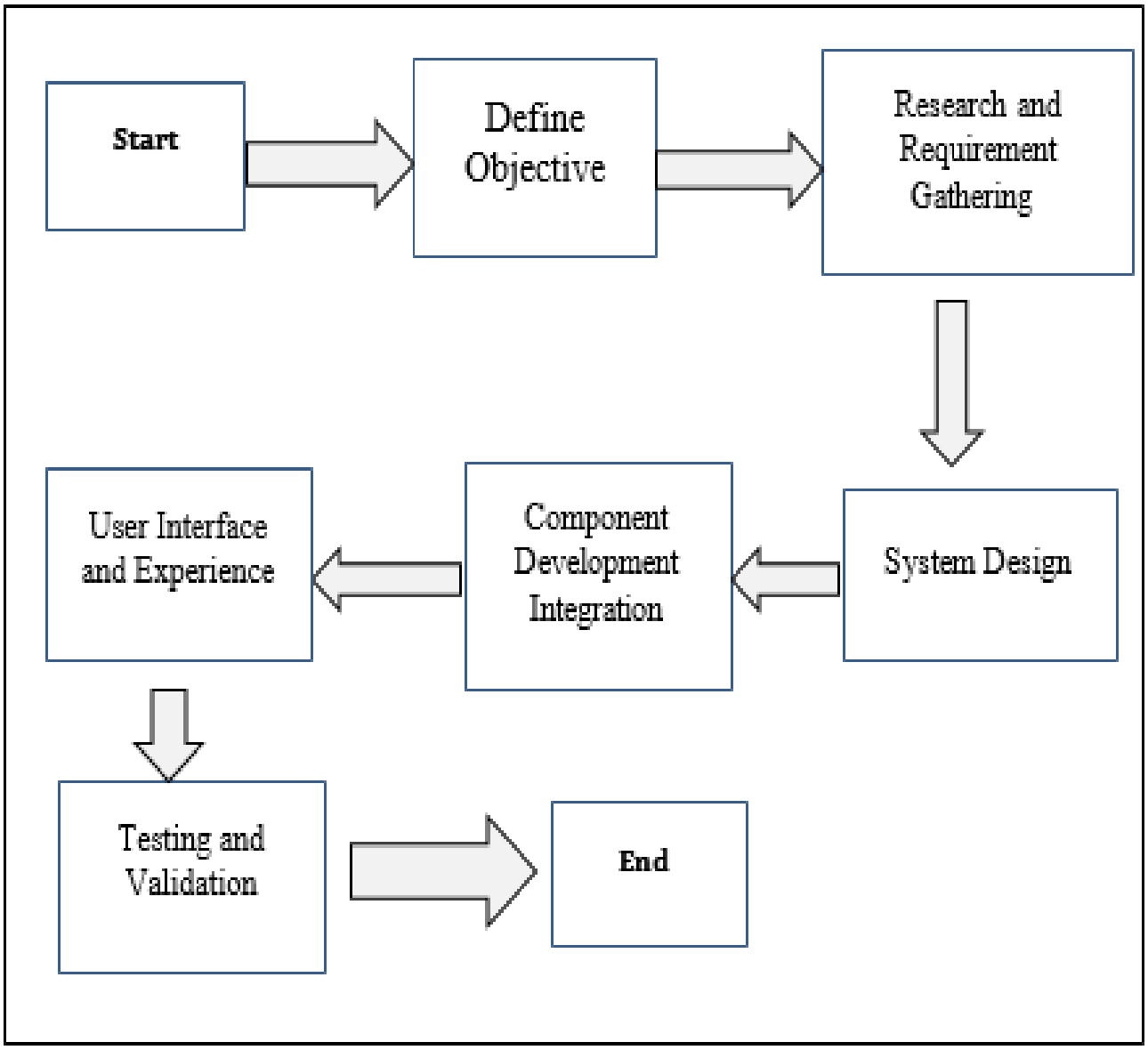

Figure 3.6-1 Flow Chart

4 Chapter 4 : Project Design

4.1 Introduction

In this chapter, we discuss all the component used in the portable dental unit and brief overview of each component in the device

4.2 The main component

Table 4.2-1 The main component of device

1-Air Compressor	2-Transformer	3-Battery
4- Air Bottle	5- Foot control	6-3-way syringe
7-High speed Handpiec	8-Suction	9-low speed Handpiece

4.3 The Secondary Component

Figure 4.3-1 The Secondary Component of device

4.4 Air Compressor

Oil-free compressors are a type of air compressor that does not utilize oil in the air compression process. These compressors offer several advantages, making them suitable for various applications. [1]

4.4.1 Advantages:

- Clean Air: Oil-free compressors produce compressed air devoid of any oil contaminants, making them ideal for sensitive systems like medical equipment, food processing, and electronics manufacturing. [1]
- Reduced Maintenance: The absence of oil eliminates the need for regular oil changes, significantly reducing maintenance costs.
- Extended Lifespan: Oil-free compressors exhibit a longer operational lifespan due to the absence of oil-induced wear and tear. [1]
- Quiet Operation: Compared to oil-lubricated compressors, oil-free compressors operate with significantly less noise. [1]

4.4.2 Types of Oil-Free Compressors:

- Diaphragm Compressors: These compressors utilize a flexible diaphragm to compress air, characterized by simple design **and** long service life. [1]
- Screw Compressors: Screw compressors employ a pair of intermeshing screws to compress air, known for high efficiency and energy-saving capabilities.
- Rotary Vane Compressors: These compressors use a series of vanes to compress air, offering a lower price point but potentially lower efficiency compared to other types. [1]

4.4.3 Applications of Oil-Free Compressor

- Medical Systems: Used in medical devices such as ventilators and anesthesia machines.
- Food Industry: Employed in food processing and packaging.
- Electronics Manufacturing: Used in the production of electronic devices.
- Pneumatic Systems: Powering pneumatic tools like air mailers and spray guns [4]

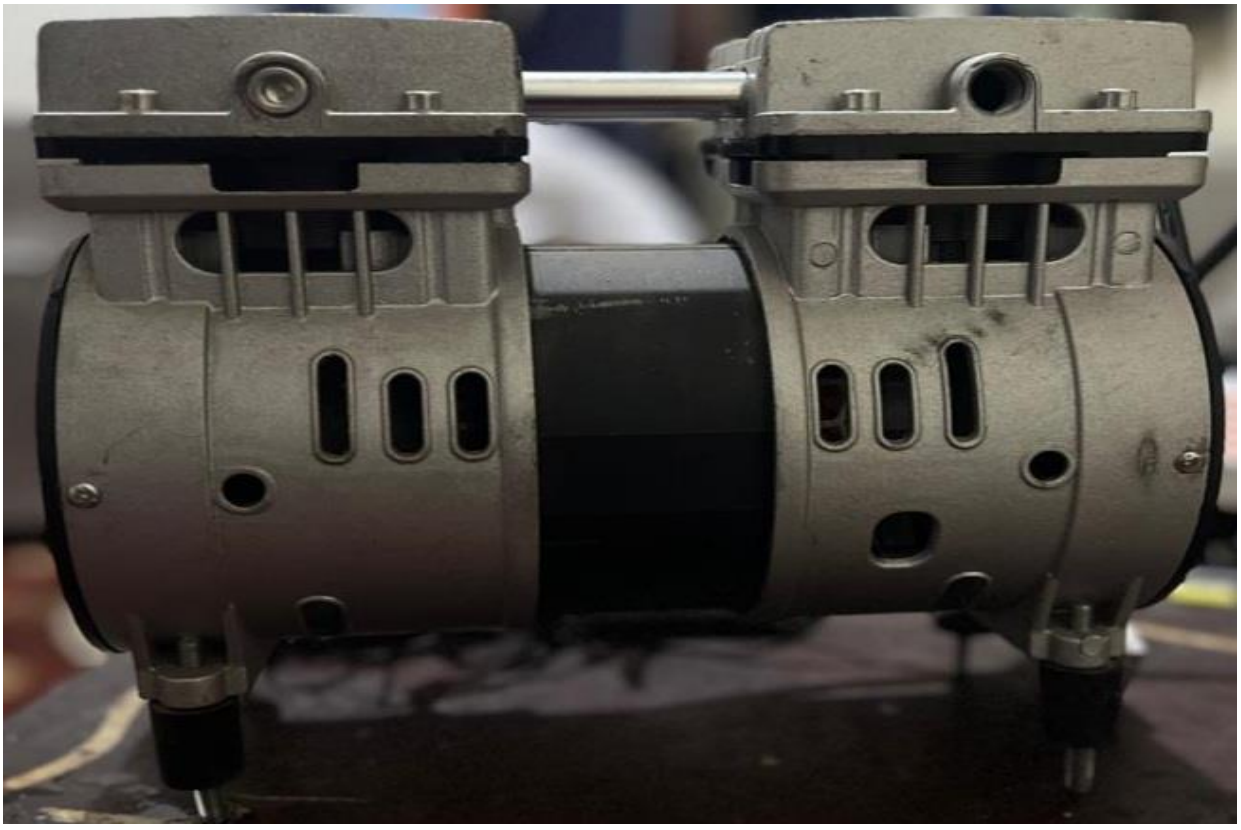

Figure 4.4-1 The Compressor

4.5 Battery Charging

A battery charger is electronic device used to charge the battery of electronic devices such as laptops its work [1]2

- Electronic Current
- Conversion
- Regulation
- charging

4.5.1 Types of battery charger

- Wall charger
- USB charger
- Wireless charger

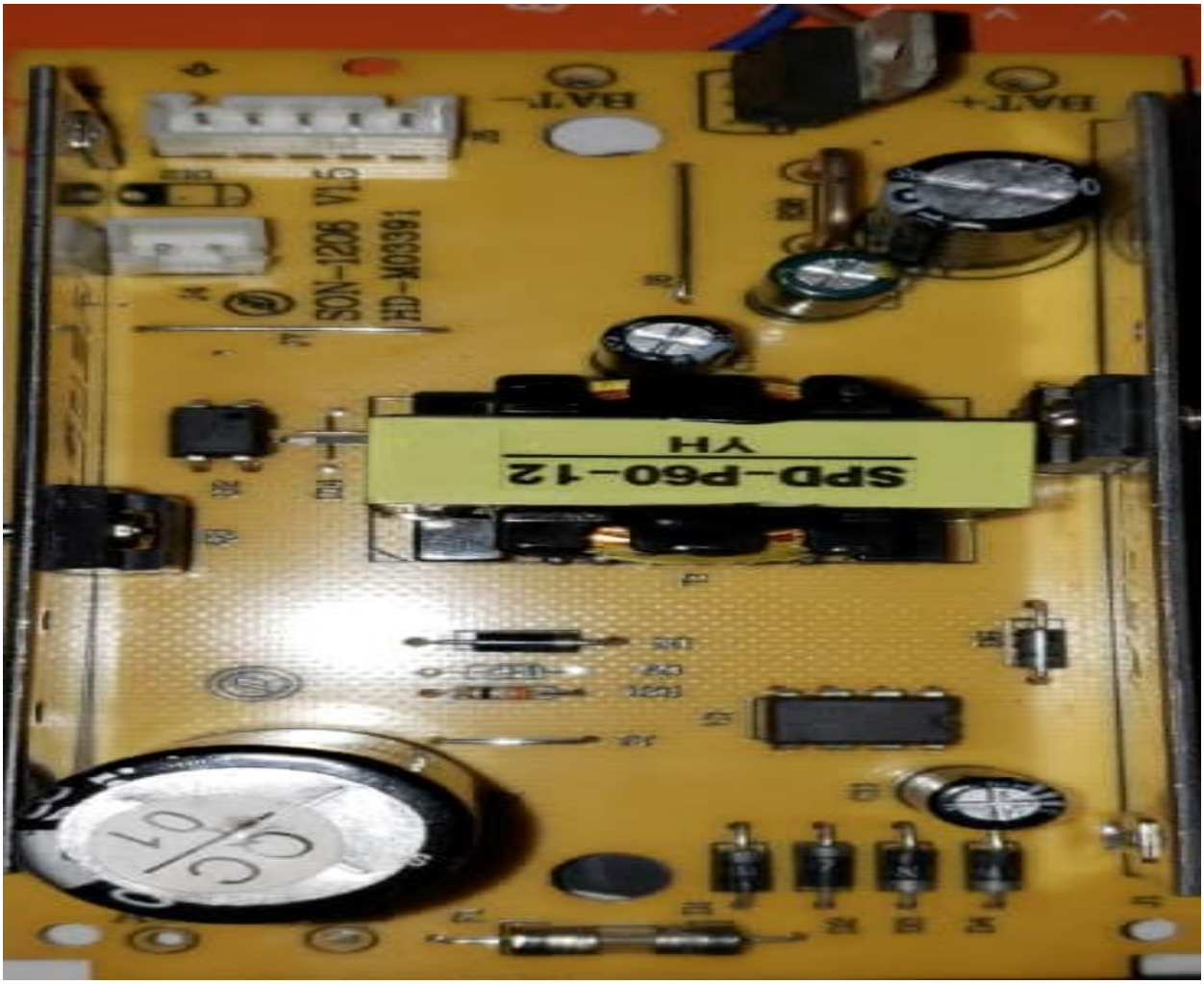

Figure 4.5-1 battery charging

4.5.2 **Inverter**

An inverter is a device that converts electrical current from a di current (DC) source to an alternating current (AC) source. The primary components of a 1500W inverter are: [1]3

4.5.2.1 Transformer:

- In an inverter, the transformer converts the input DC voltage to an appropriate AC voltage.
- magnitude of voltage change. [1]4
- If the number of turns in the primary winding exceeds that of the secondary winding, the secondary voltage will be lower than the primary voltage (step-down).
- Conversely, if the secondary winding has more turns than the primary, the secondary voltage will be higher (step-up).

4.5.2.2 **Rectifier Bridge**:

- Comprises multiple diodes.
- Utilized to convert alternating current to direct current. [14]

4.5.2.3 **Smoothing Capacitor**:

- Employed to smooth the DC waveform produced by the rectifier bridge.
- Reduces ripples in the DC voltage.

4.5.2.4 **Oscillator**:

- Generates an alternating signal of a specific frequency.
- This alternating signal is used to operate the switching transistors.

4.5.2.5 **Switching Transistors**:

- Used to convert direct current to alternating current
- Operating Principle of the Inverter:
- Direct current (DC) is input into. [14]

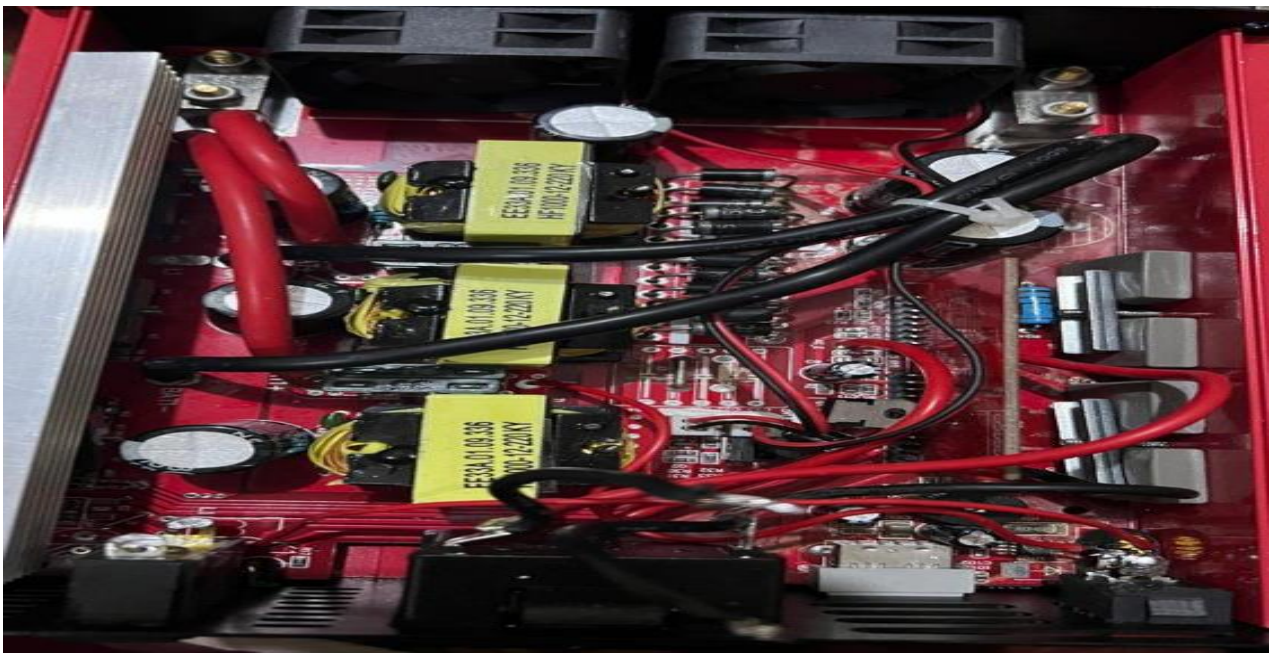

Figure 4.5-2 The inverter

4.6 **Battery**

Gel battery is a type of lead-acid battery that is regulated by a valve, where a pre-determined amount of electrolyte is mixed with fumed silica along with sulfuric acid. This chemical reaction produces a stable gel-like material, which gives these batteries their name. Two 26 Ah gel batteries were used, connected in parallel with the inverter, to power the device in the event of a power outage. [11]

Figure 4.6-1 Battery

4.7 **Bottle Air**

When starting the dental device, the air compressor begins to push air into the mobile tank، and this continues until the air pressure inside the tank reaches the required pressure, for example, 1 bar. Then the pressure switch (Pressure Switch) cuts off the electricity supply to the motor, and the air supply to the tank stops. When starting to use the compressed air and the pressure drops inside the tank, and until the pressure reaches, for example, 5 bar, the pressure switch reconnects the electricity to the motor to start the air pumping process again and deliver it to the total pressure 3,7,1The air tank has several important ports, which are as follows • :Air inlet port, which is the port that receives the air from the air compressor and delivers the inside of the tank • .Air outlet port, which is

the port that connects the air from the tank to the rest of the dental device components, usually controlled by an Air Regulator to determine the air pressure entering the device • . Pressure switch port, which is the port to which the pressure switch that controls the pressure inside the tank is connected, thus controlling the operation and stopping of the air compressor. [9]

Figure 4.7-1 Air Bottle

4.8 Foot control

Regarding the foot control in a portable dental unit, it is an important tool used for manually controlling the operation of the unit. The following provides more details. [9]

4.8.1 Principle of Operation:

- The foot control is connected to the main dental unit via an electrical cable .
- When the foot is pressed on the foot control, an electrical signal is sent to the main unit to activate specific functions, such as starting the motor or adjusting its speed. [9]

4.8.2 Components:

- The main body of the foot control containing the pressing mechanism.
- The connection cable to the main unit.

- Buttons or switches for controlling different functions. [9]

4.8.3 **Key Functions of the Foot Control:**

- Initiation and termination of the main motor operation
- Speed control of the motor rotation
- Control of the dental chair arm raising and lowering
- Activation and deactivation of water spray and air functions
- Control of lighting and suction systems[9]

4.8.4 **Foot Control Design:**

- The main body is made of durable materials like plastic or metal to withstand repeated
- It contains one or more buttons or switches to execute the aforementioned functions.
- Connection to the main unit is through a sturdy and flexible electrical cable to a dedicated. [9]

Figure 4.8-1 foot control and valve

4.9 High Speed Handpiece

High-speed handpieces work at cutting speeds over 180,000. 'They are technically categorized into Air Turbine and Speed-increasing depending on their mechanisms. In a clinical setting, however, Air turbine handpieces are most Often referred to as "I-light-speeds". Handpieces have a chuck or collets for holding a cutter, called a burr or bur. [1]5

4.9.1 Components of the Rapid Drill Circuit:

- High-speed electric motor: A powerful and highly precise motor that generates high rotational speeds.
- Electronic control system: An advanced control unit that precisely regulates the speed and power.
- Cooling systems: A set of cooling mechanisms to provide appropriate thermal management during high-speed drilling.
- Specialized drilling tools: Customized drill bit assemblies designed to operate at elevated speeds. [15]

4.9.2 Technological Advantages:

- High speed: Drilling speeds up to 40,000 revolutions per minute can be achieved.
- Precision and efficiency: The precise electronic control ensures accurate and efficient drilling operations. [15]

Figure 4.9-1 High speed Handpiece

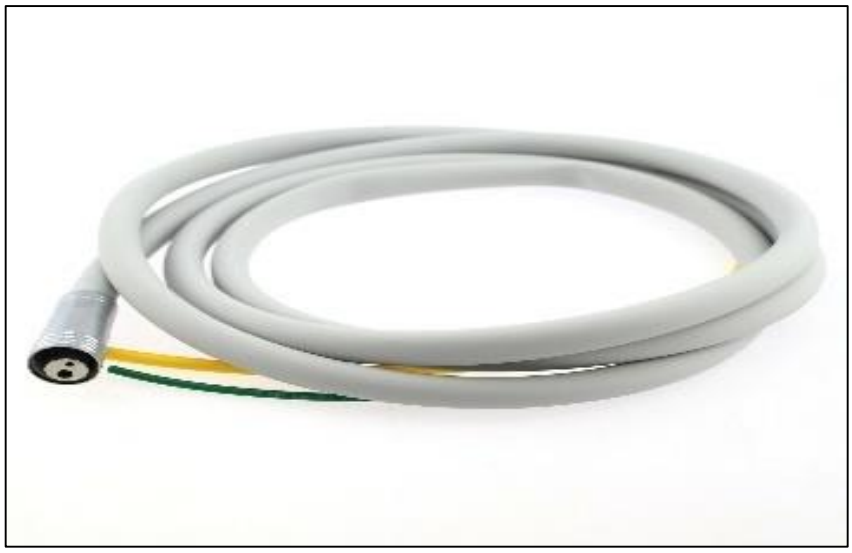

Figure 4.9-2 pep

4.10 Slow Speed Handpiece

4.10.1 Low Speed (Slow Motion) Circuit:

This is the second part of the treatment circuit, used to complete the handpiece operation, especially in areas near the tooth nerve. It is also used for cleaning tooth

surfaces using special brushes, and in the procedure of placing a pin inside the patient's tooth in some cases required by the dentist. These previous operations use a part of the slow drill circuit called the Angle Handpiece. Slow drilling is also used in surgical procedures on the jaw and utilizes another part called the Straight Handpiece. It is also used in some dental prosthetic work. [13]

4.10.2 **The Slow Drill Circuit Consists of Two Parts:**

The Hand Piece: This is the upper part of the slow drill circuit, of two types - the Angle Handpiece and the Straight Handpiece, named after the shape of the component. They are mechanical assemblies that transmit the rotational motion from the motor to the bur for the required uses. Slow speed handpieces work at a much slower rate that high speed and speed-increasing handpieces. and are usually driven by rotary vane 1110tors, instead of' air turbines. They work at a speed between 600 and 25.000 rpm. The internal gearings are very similar to that of a speed-increasing handpiece. The main d between the two is that slow has internal gearing and they use a latch grip burr as opposed to a friction grip burr. [13]

Figure 4.10-1 Low Speed Handpiece

4.11 Suction Units

This circuit is used during therapeutic procedures and is used to suction oral fluids such as saliva and blood, as well as the water flowing from the handpiece and other therapeutic components during the dentist's work. It is preferred to use it extensively during fillings and root canal treatments. The suction of fluids in this circuit is based on the Venturi principle, which states that a decrease in pressure occurs when a fluid passes through a tube at a certain speed. This pressure drop is utilized by connecting a rubber tube that reaches the patient's mouth and works to suction the oral fluids. Water is usually used in this circuit, and the stronger the water flow, the stronger the suction. The circuit consists of the Venturi component, a water valve that may be electrical or mechanical, and the tubes connected to the patient's mouth. [13]

4.11.1 Maintenance of this circuit includes:

- After each use, a cup or more of clean water should be drawn to flush the remaining blood and saliva from the tubes. [13]

Figure 4.11-1 The Suction

4.12 Way Syringe

4.12.1 Triple Syringe Circuit

This is the fourth and final part of the treatment circuit, consisting of a water line and an air line that directly reach the syringe from within the device. It is controlled by switches on the syringe itself, and it is called "Triple" because it can be used with air only, water only, or both Water alone or both in the form of a spray are used. The triple syringe is used to rinse the cavity site and dry it before placing the dental filling, and maintaining this part of the circuit is done by keeping the component clean and avoiding exposing it to shocks such falling to the ground. 3-way syringe in a portable dental unit: [12]

4.12.2 1Principle of Operation of the 3-Way Syringe:

The 3-way syringe is an essential instrument in portable dental clinics. It provides three types of fluids and air for use in various stages of dental treatments. When the handle is pressed, a diverter valve is activated that determines the type of fluid (water, air, or a mixture) that will exit the tip of the instrument. Water is used to clean the work area and remove any treatment residues, while air is used to dry the area before treatment. A mixture of water and air can also be obtained to clean and dry the area simultaneously. [12]

4.12.3 Components of the 3-Way Syringe:

The handle: It comes in different shapes (straight or curved) and the flow of fluids and air is controlled by pressing on it. [12]

Figure 4.12-1 3Way syringe

4.13 Water and Waste Bottles

The Water Bottle in the Portable Dental Unit: Functions and Operational Principles [12]

In the portable dental unit, there is a water bottle or reservoir that serves the following functions:

- Water Source:
- Water Cooling System:

The water stored in the bottle is utilized as a cooling medium to dissipate heat from the instruments and devices within the unit.

This water-based cooling system maintains the appropriate temperature of the instruments during operation.

- Irrigation and Disinfection System:

The water bottle may also contain specialized disinfecting and cleaning solutions.

These solutions are used to flush and disinfect the tubing and water systems within the unit.

- Ease of Filling and Replenishment:

The water bottle is designed in a manner that allows for simple refilling with clean water or solutions.

This facilitates the maintenance and operation of the unit's water system.

Therefore, the water bottle plays a crucial role in providing the clean water supply, enabling cooling capabilities, and facilitating disinfection within the portable dental a water bottle for clean water and a waste bottle system for collecting saliva that is removed with the low suction. It contains a built in oil less air compressor and tank to allow the user to use the unit without [12]

Figure 4.13-1 The Bottles

4.14 The Fan

The Cooling Fan of the Dental Unit:

- This fan operates to cool the internal components of the portable dental unit.
- It assists in preventing an excessive rise in temperature within the unit resulting from the operation of the instruments and devices.
- It provides the necessary cooling to maintain the performance of the unit's components within safe parameters.
- The operation of the fan is controlled by the electronic control system of the unit.
- The fan ensures the maintenance of a suitable temperature inside the unit during prolonged usage.
- This cooling fan plays a vital role in preserving the safety and efficiency of the components within the portable dental unit. [2]

Figure 4.14-1 The Fan

4.15 The Valves

The Valves in the Portable Dental Unit: Types, Functions, and Operational Principle

4.15.1 Main Air Valve:

- This valve controls the flow of the pressurized air supply to the dental unit. [2]
- It allows for the adjustment of the air volume used to power the pneumatic instruments, such as the high-speed motor and the air-powered syringe. [2]

4.15.2 Main Water Valve:

- It regulates the flow of the water supply to the dental unit.
- It enables the control of the water volume used for cooling the instruments and rinsing the treatment area. [2]

4.15.3 Water Spray Control Valve:

- This valve manages the flow of the water spray directed at the treatment site during operation. [2]

- It allows for the adjustment of the spray density and the balance between air and water. [2]

4.15.4 Cold Air Supply Control Valve:

- It controls the flow of the cold air supplied to the high-speed motor and the air-powered syringe. [2]
- It permits the regulation of the temperature of these instruments and their appropriate cooling. [2]

4.15.5 Cold Water Supply Control Valve:

- It manages the flow of the cold water supplied to the treatment area. [2]
- It allows for the cooling of the treated site, maintaining patient comfort and tissue. [2]

These diverse valves enable the dentist to have precise control over the air and water components, ensuring optimal performance and safety in dental treatment. [2]

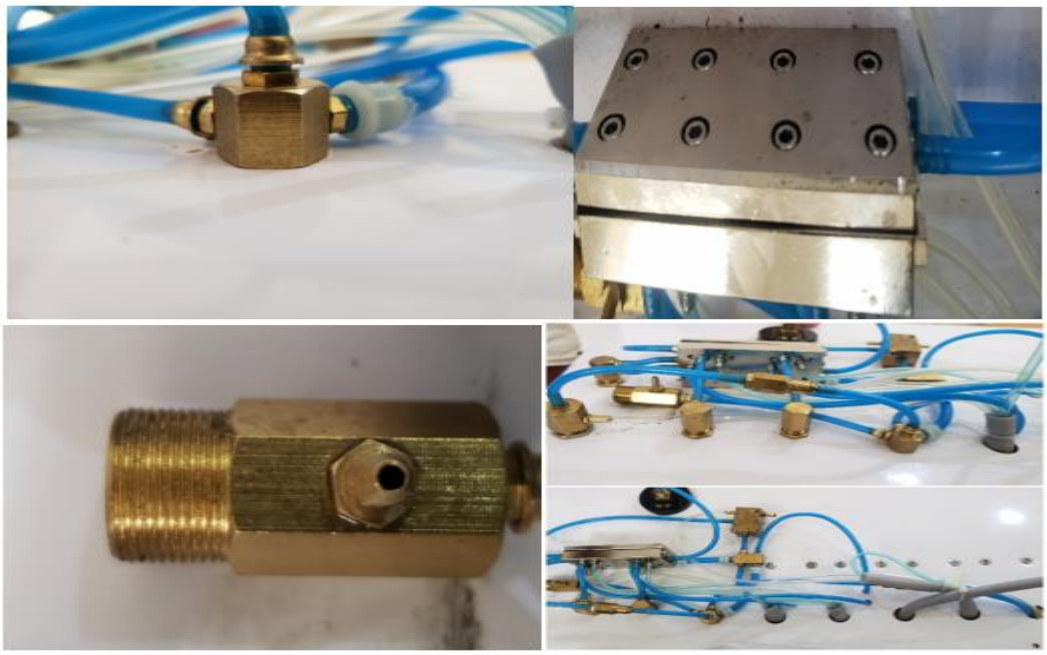

Figure 4.15-1 The Valves

4.16 Ball Bearing

The first type is the Radial Ball Bearing Turbine, which consists of the following components:

- The Rotor - This is the rotating component, made up of blades connected to two radial ball bearings, one at the front and one at the rear.
- The Ball Bearing Holder - This component holds the radial ball bearings and may be integrated with the turbine body, serving as a seat for the ball bearings.
- The Rings - These are circular rubber rings used to prevent air leakage at the front and rear of the turbine.
- The Chuck - This is a metallic or plastic component that holds the drill bit (Bur) and is placed inside the rotor.
- The Cover - This is the rear cover that protects the rotating components inside the turbine head. [9]
- These components are housed inside the turbine head, which has passages for air intake and exit, as well as a water line to cool the drilling area. [9]

The second type is the Air Bearing Turbine, which consists of the following components:

- Remedy: Replace the Chuck or the entire rotating assembly.

The Treatment:

- The water outlets in the handpiece head must be observed and cleaned.
- Ensure the water level in the distilled water tank or the air line that pressurizes the water from the water tank.
- Observe the water regulator for the handpiece. [9]

Figure 4.16-1 Ball Bearing

4.17 Air Bearing

Air Bearings

- Air pressure range: 3-3.5 kg/cm^2
- Rotational speed range: 450,000 - 500,000 RPM
- Starting rotation is more difficult due to the need to overcome friction between the components.
- Continuous rotation is achieved through the use of air bearings between the rotating part and the air bearing seats.
- A specialized air bearing spray is used for maintenance of the air bearings.
- Only alcohol is used for cleaning and maintenance, without the use of oil.
- There is no tight coupling between the vanes and the air bearings. [6]

The key points regarding air bearings are the specific air pressure and rotational speed ranges, the challenge of overcoming initial friction, the use of air bearings to enable continuous high-speed rotation, the specialized maintenance procedures using air bearing spray and alcohol, and the absence of a tight mechanical coupling between the components[6]

4.18 Pressure Gauge

The Pressure Gauge in the Portable Dental Unit: Functions and Operational Significance.

Within the portable dental unit, a pressure gauge serves the following essential functions:

- **Air Pressure Measurement:**
  - The pressure gauge measures and displays the compressed air pressure within the unit's air supply system.
  - This allows the user to monitor the air pressure and ensure it is maintained at appropriate levels for operation.
- **Air Pressure Control:**
  - The readings from the pressure gauge enable the user to adjust and regulate the air pressure supplied to the pneumatic instruments.
  - This ensures the instruments operate with the correct force and speed.
- **Maintenance and Troubleshooting** [6] :

.

Figure 4.18-1 The Pressure Gauge

4.19 Air /Water Circuit Diagram

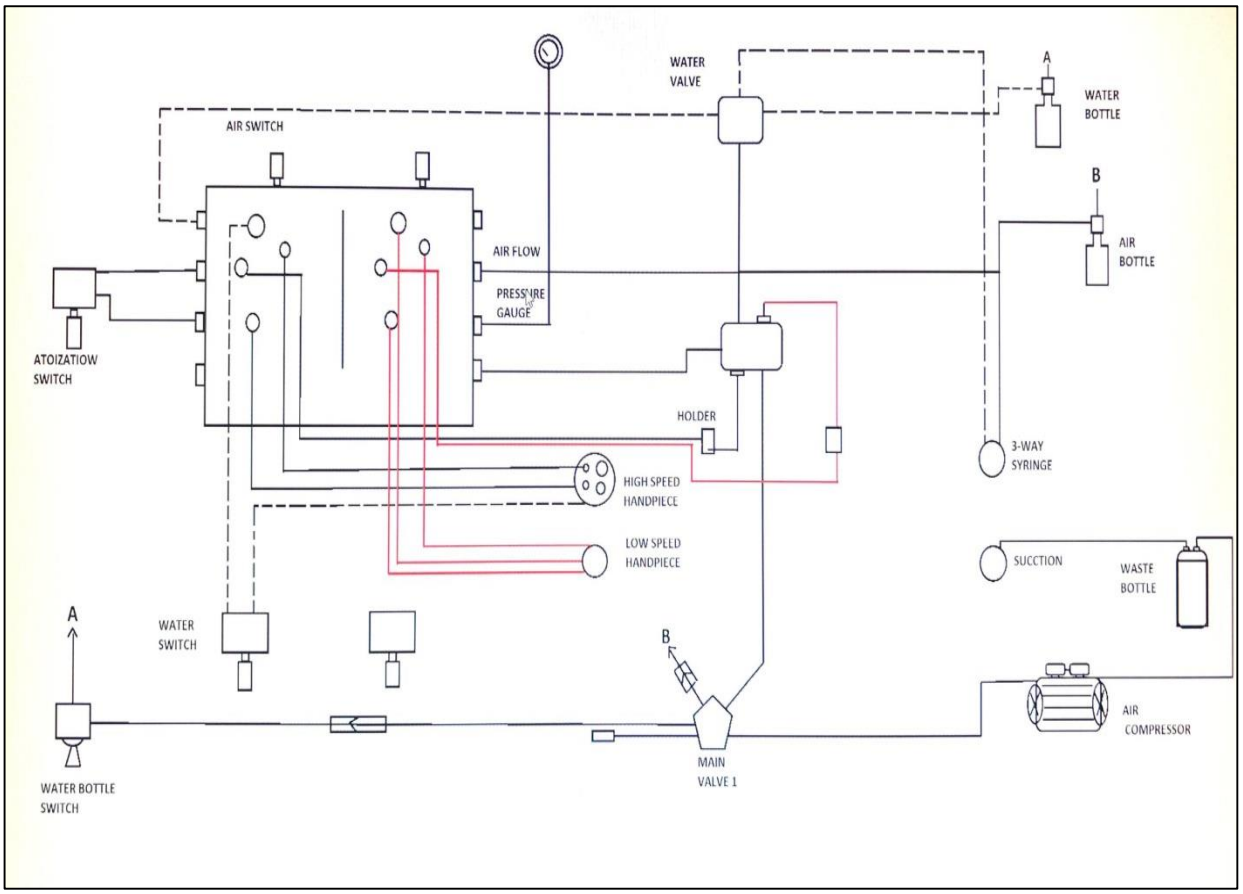

Figure 4.19-1 air /water Circuit Diagram

5 Chapter 5
Implementation and Test

5.1 Introduction

In this chapter, we will explain the design of the device and how to install it in detail, how to design the device, and what are the stages of designing the device with appropriate dimensions that match and are consistent with international standards in the manufacture of medical devices. A medical device that meets the requirements of children and makes it easy to move, has a calm color, and is comfortable for its users discuss the methods of connection, Implementation and Test for devices, components, valves, and connective parts related to the portable Dental unit. [8]

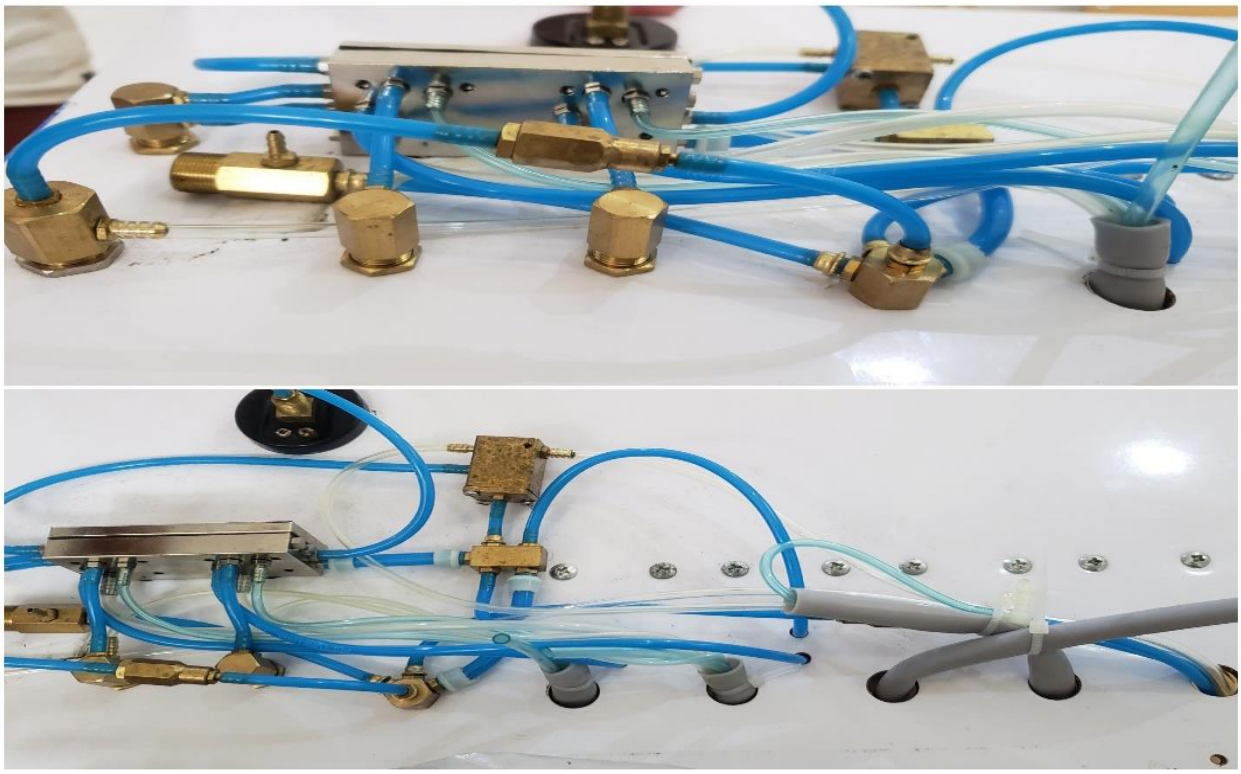

Figure 5.1-1 connective parts related to the portable Dental unit.

5.2 stages of device design

stages of device design

Power Supply: The primary source of power for the equipment, often a rechargeable battery.

Battery Charging Circuit: Charges the battery.

Battery: Stores energy to power the equipment.

Inverter: Converts battery power to the appropriate voltage for operating the equipment components.

Compressor: Generates the air pressure required to operate the handpieces.

Foot Control: Used to control the operation and stopping of the equipment.

Clean Water Bottle: Supplies clean water for cooling and cleaning.

Suction Tube: Used to aspirate fluids from the mouth during procedures.

Syringe: Used to Inject liquid materials.

Handpieces: Used to perform various procedures, such as drilling or polishing.

Operating Process:

1. The equipment Is powered on using the power supply or battery.
2. Air pressure produced by the compressor is used to operate the handpieces.
3. The foot control Is used to control the operation and stopping of the equipment.
4. Clean water Is used for cooling and cleaning the instruments.
5. The suction tube Is used to remove fluids from the mouth.
6. The syringe Is used to Inject liquid materials.

Figure 5.2-1 Device

5.3 Air Unit

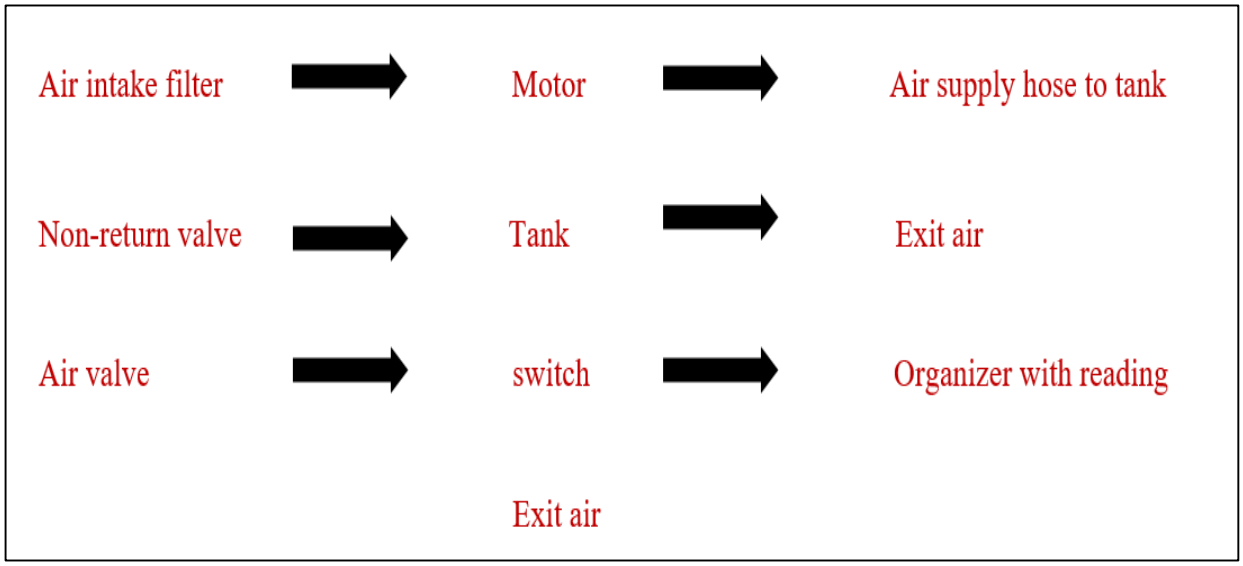

Figure 5.3-1 Air Unit

5.4 Water Unit

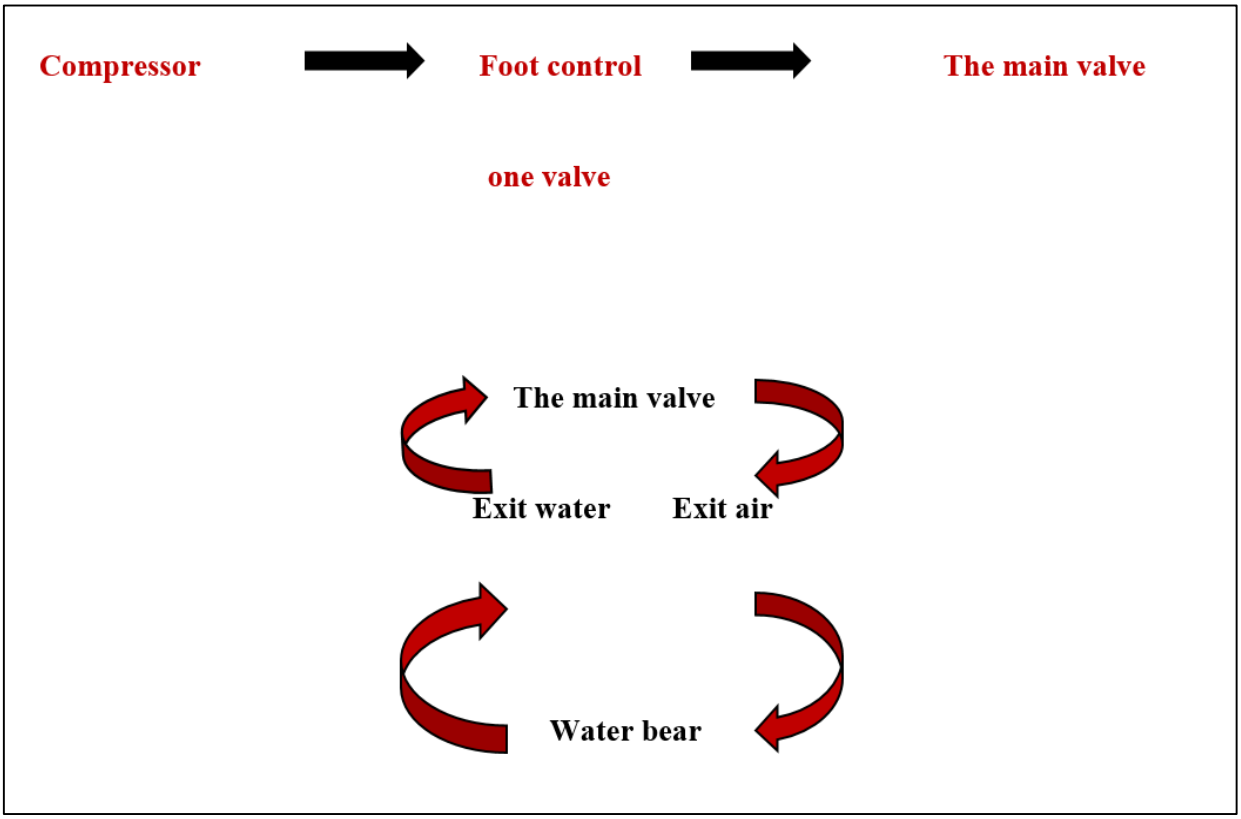

Figure 5.4-1 Water Unit Flew Char

5.5 Valve Opening Closing

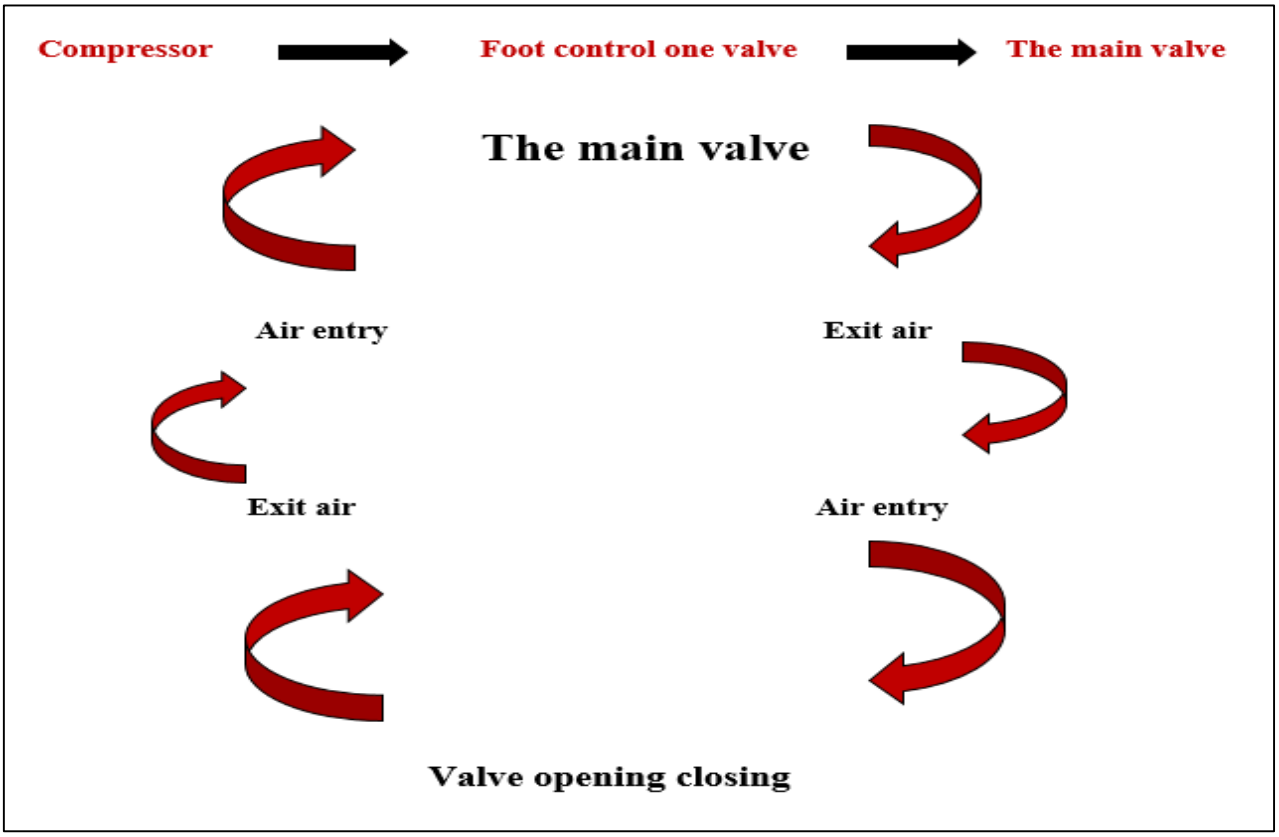

Figure 5.5-1 Valve Opening Closing

5.6 Awaken The Turbine

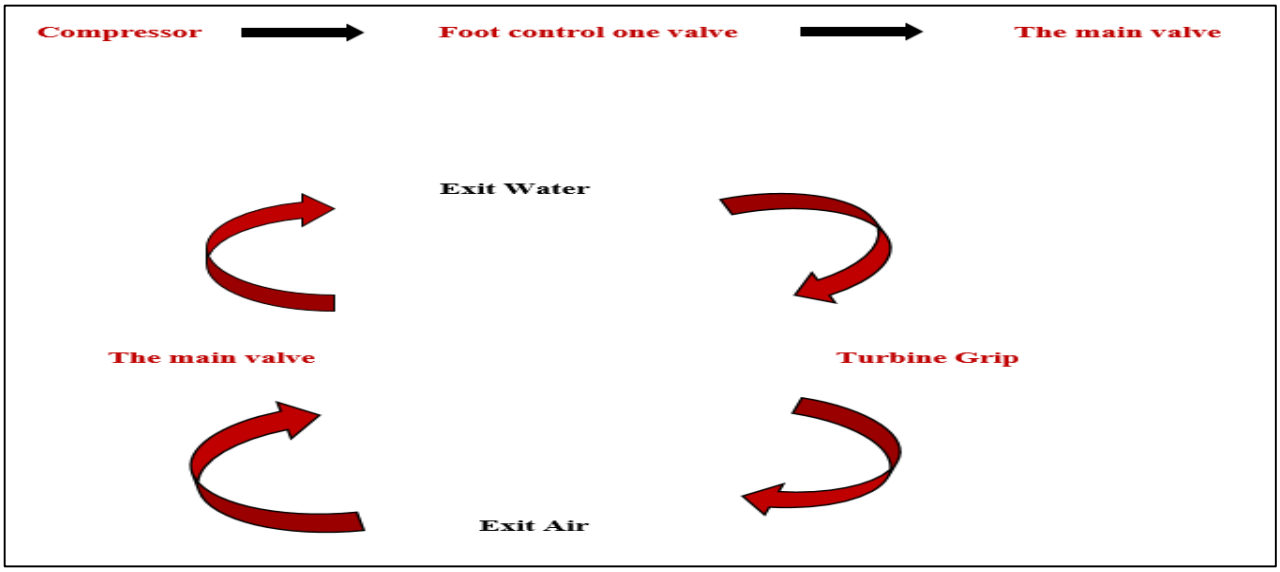

Figure 5.6-1 Awaken The Turbine

5.7 Saliva Pipette

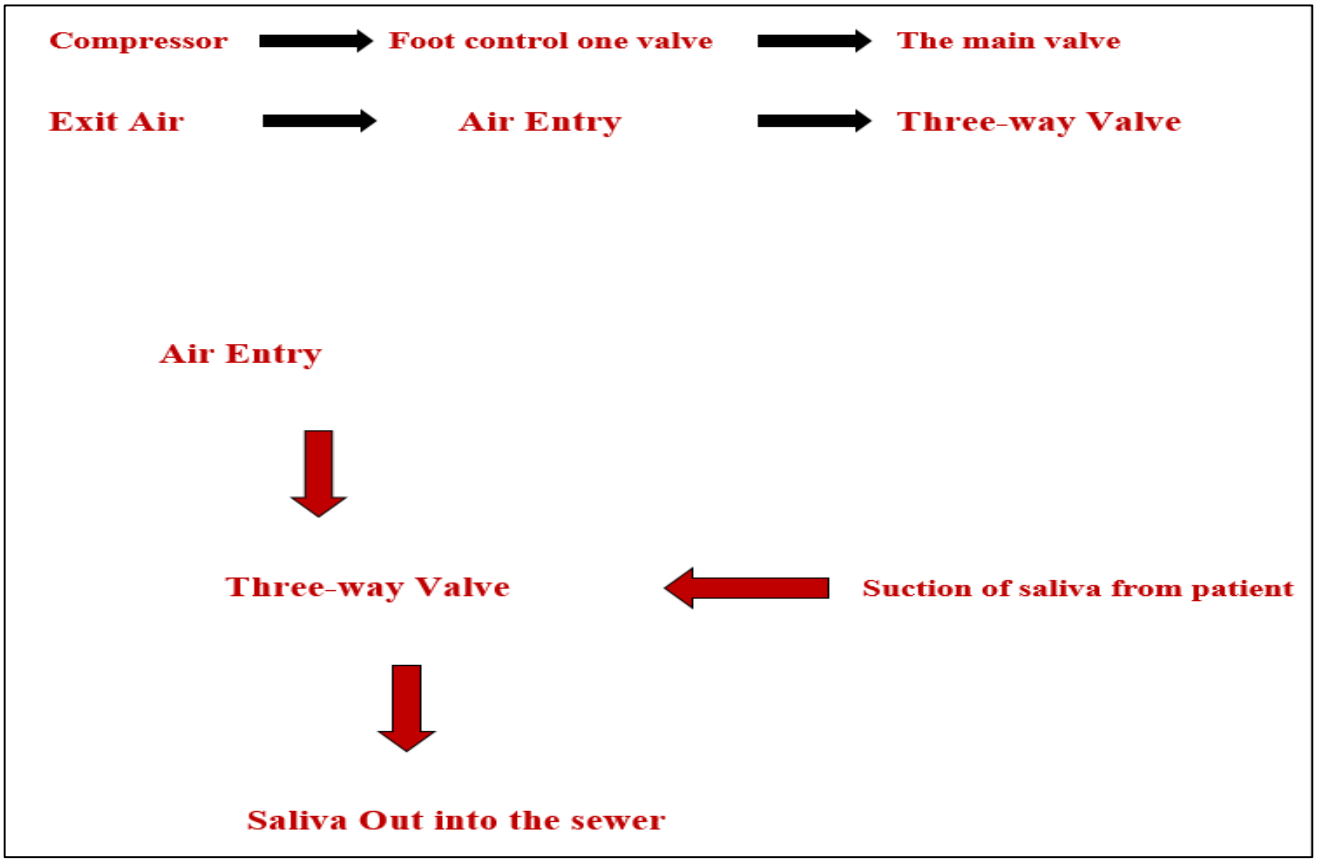

Figure 5.7-1 Saliva Pipette

5.8 Triple Syringe Unit

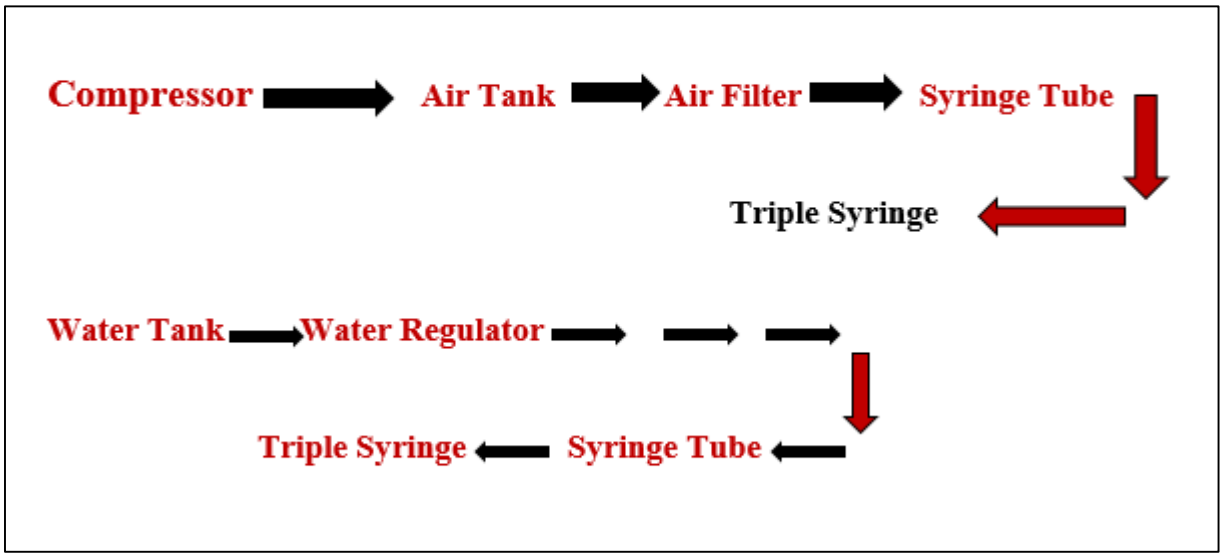

Figure 5.8-1 Triple Syringe Unit

5.9 **Low Speed**

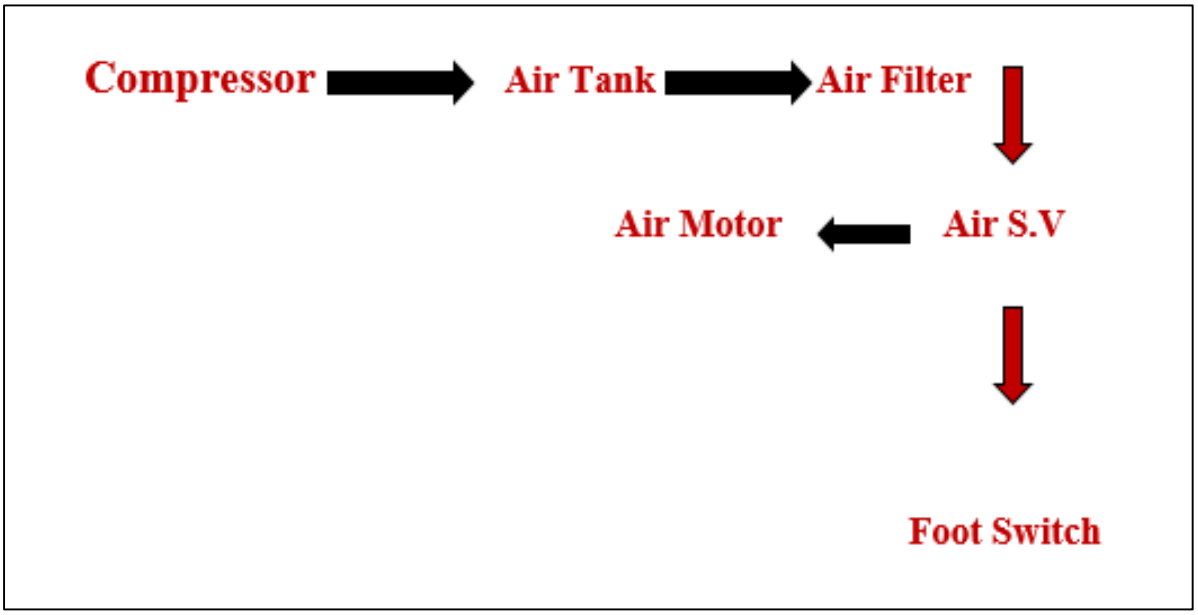

Figure 5.9-1 Low Speed diagram

5.10 **High Speed**

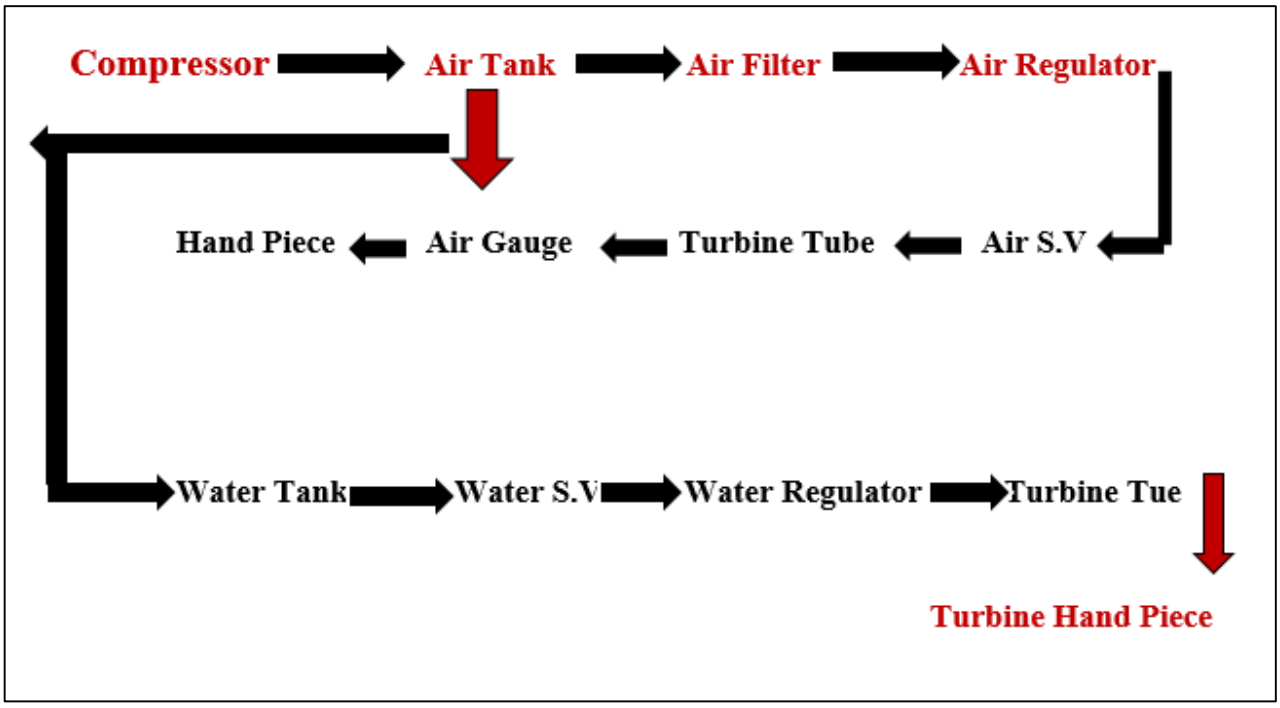

Figure 5.10-1 High Speed diagram

6 Chapter 6 : Results

6.1 **Results**

The portable, battery-powered dental unit was tested after connecting all its electrical

and mechanical components. The following results were observed:

- The powerful motor is well-suited to the actual requirements for operating medical instruments.
-
- The integrated battery operates for 45-60 continuous minutes before requiring recharging, which meets the needs of typical usage.
-
- The electronic control unit functions with high efficiency and provides speed adjustment capability.
-
- The external housing was designed to be robust and flexible.

Comparing these results to the previously specified requirements, it is clear that the portable dental unit fulfills all the designated criteria. This confirms the successful design and implementation of this system.

Figure 6.1-1 dental unit

7 Chapter 7 : Conclusions and Features Work

7.1 Conclusions

In Conclusion, the portable dental unit is an advanced medical tool designed to provide dental services in remote or underserved areas where such services are not readily available. This unit is distinguished by its ability to operate on both electricity and battery power, making it versatile and usable in various locations The portable dental unit includes a comprehensives et of equipment and devices necessary to perform most basic dental procedures. For instance, it provides both manual and electric dental tools, along with an advanced treatment unit. This enables dentists to conduct routine and emergency dental examinations and treatments directly in areas lacking traditional dental facilities. One of the primary advantages of the portable dental unit is its capability to operate on both electricity and battery power. This independence. from fixed power sources allows its use in remote and rural areas where the electrical grid may not be available. These units are equipped with powerful batteries capable of running the unit for several hours without the need for recharging. Additionally, the portable dental unit is characterized by its compact and mobile design. Typically, it is small in size and lightweight., making it easy to transport and store. It can be easily moved using special bags or carts, facilitating its transport to various locations. This mobile aspect is a significant advantage, enabling dentists to reach distant and remote areas that lack dental services from a technical perspective, the portable dental. includes a sophisticated array of electronic and mechanical components. For example, the central processing unit features a powerful processor that manages all the unit's functions, including the control of electric tools. The unit is also equipped with a high-quality LED lighting system to provide optimal illumination during procedures. Furthermore, the portable dental unit is fitted with an efficient cooling the system to ensure the devices operate effectively even in challenging climatic conditions. This compact and reliable design allows the unit to be used in diverse environments without compromising its efficiency or patient safety. which operates on both electricity and battery power, represents significant technological innovation in the field of dentistry. This unit provides access dental care in underserved areas, thereby improving the health and well-being of the population in those regions. Thanks to its independence from fixed electrical sources and its mobile and compact design, the portable dental unit has become a valuable tool in delivering dental services to remote and isolated. [10]

Figure 7.1-1 Teeth care

7.2 Features Work

- Compact and light weight design.
- Add Scalar and Light cure System.
- Built in water supply and drainage system.
- Adjustable dental chair.
- Integrated dental tools and accessories.
- Portable X-ray machine.
- A connected camera with screen.

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