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Gastric Acid Detection Device for Cancer Patients

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Abstract*—Management of treatment in cancer patients is still dominated by chemotherapy. Chemotherapy is a method used to reach cancer cells so that cell growth can be inhibited and controlled. Implementation of this action with side effects that can cause nausea and vomiting, thereby affecting the nutritional balance. Other nausea effects of vomiting can also cause dehydration, electrolyte imbalance, risk of aspiration and stress. Reducing the effects that occur in these patients, pharmacology given with the appropriate dose. The administration of nausea and vomiting drugs is only given by only looking at clinical manifestations without first detecting the gastric acid of the cancer patient. This research was a development research that used to develop a prototype pH sensor in detecting hydrochloric acid. The research began by analyzing needs, making product planning, and developing product prototypes to testing limited to cancer patients. The development of prototypes designed in this study began by using a pH sensor whose data will be read on a pH analog. Signal data from the pH sensor can be raised on the LCD prototype. Hydrochloric acid detection devices can be used by the physician-nurse team as a diagnostic device to provide both pharmacological and non-pharmacological care to cancer patients.

Keywords: nausea-vomiting, cancer patients, hydrochloric acid, chemotherapy

I. INTRODUCTION

Cancer patients are palliative patients who need treatment that aims to improve their quality of life through prevention and negation by early identification and orderly assessment and management of pain and other problems, physical, psychosocial, spiritual and cultural [1,2,3]. The quality of life of palliative patients is done by looking at the early symptoms of the biopsychosocial spiritual aspects of the legal and cultural aspects of each palliative patient.

The prevalence of case based on WHO data in 2012 showed 14.1 million were new cases of cancer. A total of 8.2 million cancer sufferers died and 32.6 million sufferers lived with cancer diagnoses. Indonesia as a developing country has a high prevalence rate [4]. Basic health research states that the prevalence of cancer is the 3rd highest disease case with the most cases in the D.I Province of Yogyakarta at 4.1 per 1,000 population. South Sumatra Province as one of the provinces on the island of Sumatra contributed to the incidence of cancer by 0.7 per 1000 population [5].

Treatment management in cancer patients consists of surgical techniques, chemotherapy, and radiotherapy. Some effects on treatment can be felt by these patients. Effects such as nausea and vomiting are one of the physical symptoms felt by the patient after the chemotherapy [6]. Overcoming this, health workers provide several measures to treat nausea and vomiting by providing supportive therapy in the form of anti-emetic drugs in patients post-chemotherapy.

Nausea and vomiting are the effects that can reduce metabolic disorders because chemotherapy can cause gastrointestinal mucosal disorders and cause neurotransmitter expenditure including 5HT3 (5 Hydroxytriptamine). Based on research obtained data that palliative cancer patients face the effects of chemotherapy in the form of nausea and vomiting [7]. Researchers tried to conduct a preliminary study and obtained data to prevent the occurrence of nausea and vomiting in patients in the effects of chemotherapy. Health team give antiemetic drugs without first measuring the level of patient needs based on the pH level of stomach acid.

The hydrogen potential (pH) of hydrochloric acid produced by the stomach can be measured in several ways including by using an endoscope and a Bayes system. Bayes system is considered to be able to help doctors and paramedics to map the symptoms felt by patients [8]. The diagnosis is correct for digestive problems in patients up to now only based on symptoms and not based on measurements of gastric acid pH. Gastric acid pH measurement as a one diagnostic test should be a supporting examination that can be considered later in providing pharmacological or non-pharmacological treatment [9].

II. METHODS

This research was a research development by following the development research cycle which consists of ten steps, namely; 1) Requirement analysis and literature study, 2) Product planning, 3) product prototype development, 4) limited testing, 5) major product revisions, 6) field testing, 7) Product improvement, 8) field trials, 9) product revisions final, and 10) Dissemination and implementation [10]. This study

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Materials

pH sensor design uses several devices that support, namely the E201-C pH sensor, Arduino Uno microcontroller, data logger shield, LCD 2004 + 12C backpack, pH meter and cable connector.

System design

system design in hydrochloric acid detector consists of a pH meter circuit analog meter E201-C, a minimum microcontroller system circuit, LCD circuit. The system diagram used in this design is:

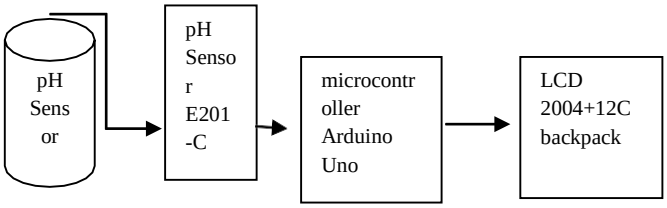

Figure 1: the diagram of the pH sensor

Circuit design

pH sensor is a series consisting of systems that work automatically. This automatic system is modified by using the series depicted in the fig. 1. This system circuit uses a microcontroller to measure the pH meter of the released hydrochloric acid.

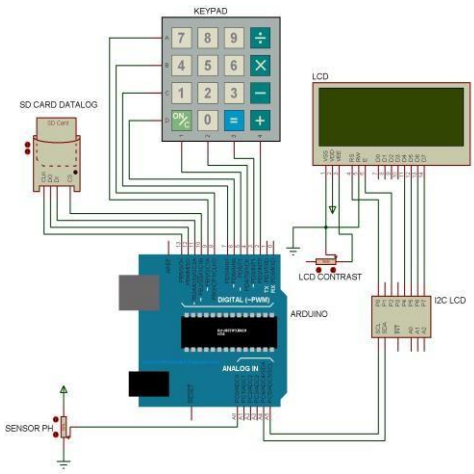

Figure 2: circuit system of the pH sensor

III. Result

Prototype in the study of manufacture using a pH sensor that will detect hydrochloric acid by using a direct method that is dipping directly at the tip of the sensor. The tip of the sensor that detects the acidity will result in ion exchange between the electronics and the measured solution. The ion exchange will create an electric current so that a voltage will be obtained. The voltage that will come from the pH sensor will be processed at Arduino Uno and converted to ADC. This ADC will function to process data so that the data will be displayed on the LCD screen (Fig. 3).

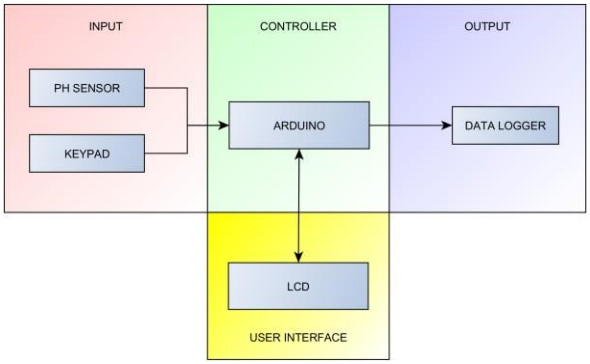

Figure 3. input and output diagram of the pH sensor

IV. Discussion

Based on the specifications of the tools and materials put forward under the making of this prototype consists of several components that are interrelated with one another. The degree of pH will be detected by the electrodes (measured probe) which are on the pH sensor, this tool will measure the amount of H_3O^+ ions in the solution. The tip of the electrode (bulb) containing HCL solution (0.1 mol / dm^3) which will have the ability to exchange positive ions (H^+) with the measured solution. If the solution is acidic, the H^+ ion will be bound to the bulb surface. The ion exchange that occurs at this time becomes an important time in pH measurement. Hydrochloric acid pH is an aqueous solution of hydrogen chloride (HCl) gas [11].

Chloride acid is a strong acid and is a major component of stomach acid. This compound is also widely used in industry. Hydrochloric acid must be handled in the right way because it is a very corrosive liquid. Hydrochloric acid is an important substance in the stomach must have a stable pH that is in the value of 3.0-7.0 [12]. Gastric acid is said to be hypoacidity when the pH is more than 3.5 and hyperacidity when the pH is less than 2 [13].

The measured pH will then be recorded on a data logger that can record data from time to time both integrated with sensors and instruments. Data logger is a tool for data logging. Physically small data loggers and their devices are equipped with microprocessors and internal memory that are used to record and record data and sensors. The results of this measurement will be displayed on a Liquid Crystal Display (LCD) whose viewer uses liquid crystals as material to display data in the form of text or images.

Measurement of gastric acid by other means can use a device that is inserted into the stomach, namely eosophagogastroduodenoscopy [14], this tool can directly measure and take the pH of stomach acid directly. However, this method has not been made the main examination in

patients who experience problems in the digestive tract, because this examination is invasive and requires coordination of many people and requires a separate room [15].

The prototype that was designed in this study is possible to get the pH of gastric acid from saliva. Saliva is a physiological fluid that has the potential to assist in making a diagnosis. The diagnosis can be made by detecting a sample of saliva Saliva is a liquid consisting of a water component (99.5%), and a mixture of inorganic salts, enzymes, and proteins (0.3%). The salivary components and the viscoelastic behavior of saliva are responsible for a variety of functions that can be organized into lubrication, microbial homeostasis, tooth protection, digestion process, taste, buffering, mineralization and wound healing. The pH level in saliva ranges between 6.0-7.0 with an increase of up to 7.4 when getting stimulation [16,17,18]. The composition of components in the saliva undergo significant changes when the patient vomits. This indicates that if the patient experiences nausea and vomiting then, the quantitative and qualitative arrangement of bicarbonate will also be affected because the bicarbonate structure is a very strong arrangement [19]. This will be a clue for researchers to be able to detect the pH of gastric acid through the patient's saliva.

V. CONCLUSION

The development of this prototype can be a diagnostic support tool in supporting the treatment of patients after chemotherapy. Besides, this type of prototype also provides the right reasons for providing both complementary and pharmacological interventions.

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