

“Design and Development of Acid Reflux Controller Device”

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by

Eshan Dhakate (A-12)

Siddhant Tiwari (A-50)

Krishna Thakur (A-68)

Krish Tomar (A-69)

Guide

Dr. B.M. Hardas

Dr. Nilesh Mahajan

RCOEM
Shri Ramdeobaba College of
Engineering and Management, Nagpur

DEPARTMENT OF ELECTRONICS ENGINEERING
SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR
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Synopsis

1. Introduction

With the change in lifestyle of people, there is an increase in the number of people suffering from gastro (stomach) related diseases. Gastroesophageal reflux disease (GERD) occurs when stomach acid frequently flows back into the tube connecting your mouth and stomach (esophagus). The lower esophageal sphincter, a valve at the end of the esophagus, malfunctions when food enters the stomach, causing acid reflux. You then experience acid backwash, which causes a sour taste in your mouth and throat after it travels back up through your esophagus. Other potential causes can include obesity, smoking, diet, and pregnancy, among others. GERD can also be due to various conditions, including abnormal biological or structural factors. The typical symptoms of GERD are frequently enough to make the diagnosis, but less typical symptoms and indications, like dysphagia and a persistent cough, can also happen. Antacids are used to get relief from acid reflux.

Lifestyle plays an important role in the prevention of GERD. Due to the improper and fast lifestyle, people follow these days there is an increase in people suffering from GERD. Environmental and genetic factors play an important role in GERD. For people living in the West, they are more prone to eating non-vegetarian food. On the other hand, people living in Asia say India are prone to eating vegetarian food, the concentration of stomach acid required for digesting non-vegetarian food is high as compared to vegetarian food hence there are increased chances of GERD in people eating more non-vegetarian food.

To test people whether they are suffering from GERD, various tests have been developed over recent years. The esophageal pH test is commonly used to confirm the diagnosis of GERD. Conventionally, ambulatory 24-hour catheter pH monitoring was performed where a catheter was kept 24 hours at 5 cm above the lower esophagus sphincter. After certain years, the Bravo pH wireless system was developed to overcome problems faced by conventional pH monitoring. Mainly 2 problems were identified in conventional pH monitoring systems which are discomfort among the patients due to size and wrong placement of the tube in the esophagus. The Bravo wireless system overcomes these limitations. Though cost is an important consideration over here since Bravo pH wireless system is really costly than the conventional pH monitoring system. Our work is focused on developing such a prototype where we will be detecting pH change. When there will be rapid change in pH value in the esophagus, then acid reflux will take place. So, after detecting the acid reflux, there will be some amount of antacid present which will help control the acid reflux.

2. Motivation

Acid reflux is produced by a weakening or relaxation of the lower esophageal sphincter (valve). Normally, this valve will close tightly once food enters your stomach. When it relaxes even though it shouldn't, the contents of your stomach climb back up into the esophagus and cause irritation.

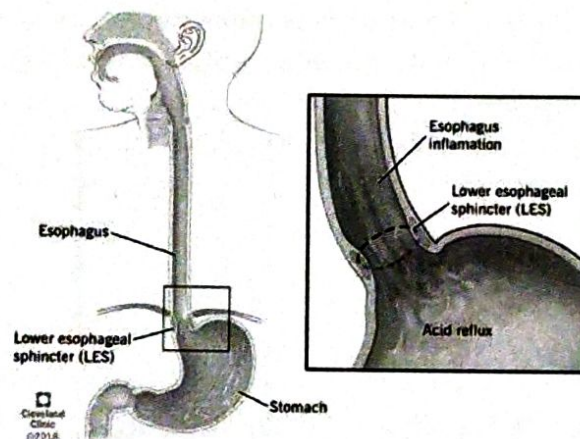


Figure 1 :- Acid reflux flow back

Few symptoms of GERD are :

- Heartburn.
- Regurgitation (food comes back into your mouth from the esophagus).
- The feeling of food caught in our throat.
- Coughing.
- Chest pain.
- Problem swallowing.
- Vomiting.
- Sore throat and hoarseness & etc.

inspite of the fact that GERD isn't life-threatening or dangerous in itself. But long term GERD can lead to more serious health problems. so the detection and prevention of it is necessary.

Some of the very serious issue causes in human body due the long term acid reflux are,

- Esophagitis : Esophagitis is the irritation and inflammation caused by stomach acid in the esophageal lining. Esophagitis can cause esophageal ulcers, heartburn, chest pain, bleeding, and swallowing difficulties.
- Barrett's esophagus : Barrett's esophagus is a disorder that occurs in roughly 10% of people who have long-term GERD. The damage that acid reflux can inflict over

time can affect the cells in the esophageal lining. Barrett's esophagus is a risk factor for esophageal cancer.

- Strictures : Sometimes the injured esophageal lining scars, resulting in esophageal narrowing. These strictures can make eating and drinking difficult by blocking food and liquid from reaching the stomach.

To deal with such a serious cause and to maintain good health we must have to avoid this acid reflux backlash but this natural phenomenon might occur in any situation in any human body. This issue especially causes more trouble in old age people and this can become life threatening to them but prevention might not be possible in their case, so in such cases a need for a smart 'Acid Reflux Controlling' device has been necessary. so we came with this "Acid Reflux Controller" device concept.

3. Related work

We have referred to various research papers from IEEE Xplore and Science Direct. Our literature survey was done on those selected papers. Some glimpses from those papers are as follows,

1. In the paper "Evaluation of Gastroesophageal Reflux Disease Using the Bravo Capsule pH System" [1], a study regarding the Bravo Capsule has been given and we have learned about Gastroesophageal Reflux Disease. This GERD occurs when stomach acid frequently flows back into the tube connecting our mouth and stomach (esophagus). This backwash irritates the lining of the esophagus. Ambulatory 24-hour catheter-based pH monitoring has been discussed in this paper, and it helps to test GERD that correlates symptoms with acid reflux episodes. One more thought regarding wireless pH sensing has been given where we can attach the device 5 cm above the lower esophageal sphincter which later helps to monitor esophageal acid exposure.
2. In the paper "Value of extended recording time with wireless pH monitoring in evaluating gastroesophageal reflux disease" [2]. This paper also contains a study about Bravo Capsule, same as the above one, but the implementation of the capsule on the human body has been done and its outcomes have been given in it. The subjects for study represent a subset of adult patients (18 years old) who have undergone extended ambulatory pH monitoring with the Bravo pH capsule system. A total of 157 subjects (aged 47–1 years; 100 women) were included in this study. Of these, 87 (55.4%) recorded typical reflux symptoms, whereas the remaining 70 subjects (44.6%) had atypical symptoms potentially attributable to GERD (chest pain 43, cough 18, other complaints 9)

3. In the paper “Swallowable sensing device for long-term gastrointestinal tract monitoring” [3], A swallowable sensor device that can be ingested orally has been proposed. this at later arrives to the stomach, where the device can indwell for a long term and can be egested at any time after it is triggered using wireless communication. also This device can inflate a silicone balloon (50 ml) in the gastrointestinal tract using a chemical reaction. The balloon with 50 ml volume does not interfere with stomach contents from moving down into the intestinal system. The balloon can be deflated later using electrolysis of water at the time of egestion. A motorless chemical-reaction-based egestion method is proposed to minimize the sensor device size. This device can achieve long-term monitoring in the gastrointestinal tract. This method requires no actuator or circuitry, which gives it a smaller volume and lower power consumption for the sensor device.
4. In the paper “Protection Against Gastric Ulcer by Verapamil” [4]. A calcium channel blocker was tested on rats against stress (cold restraint), aspirin, and pylorus ligation, which produces stomach ulcers. In all three forms of ulcers, verapamil decreased the ulcerogenic response and the ulcer index. Verapamil reduces total and free gastric acidity without altering stomach pH secretive volume.
This whole study was conducted on adult albino rats (120-150 g) of either sex. The increase and decrease of pH level among the rats has been tested, and this study has also found that Verapamil has also been found to be effective in inhibiting the gastrin induced acid secretion in healthy human subjects.

4. Proposed Methodology

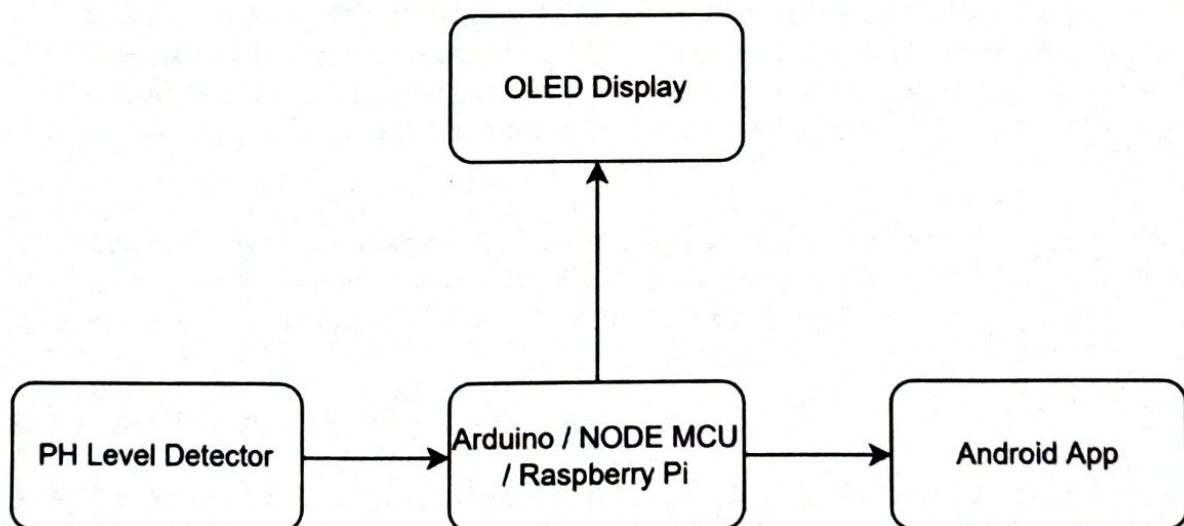


Figure 2 :- Block Diagram of Acid Reflux Detector

The block diagram consists of the following components :-

pH level detector :- A pH sensor helps to measure the acidity or alkalinity of water with a value ranging from 0 to 14.

OLED display :- Organic Light-Emitting Diode (OLED) is an abbreviation for Organic Light-Emitting Diode. OLED displays are self-emitting technologies composed of a thin, multi-layered organic film sandwiched between an anode and a cathode. In contrast to LCD technology, OLED does not require a backlight. OLED has numerous applications and is widely regarded as the most advanced technology for the next generation of flat-panel displays. OLEDs are used to make digital displays for television screens, computer monitors, and portable systems such as smartphones, handheld game consoles, and personal digital assistants (PDAs).

NodeMCU ESP8266 :- The NodeMCU ESP8266 development board includes the ESP-12E module, which contains the ESP8266 chip, which is powered by a Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at an adjustable clock frequency of 80 MHz to 160 MHz. To store data and programmes, NodeMCU has 128 KB of RAM and 4MB of Flash memory. Its high processing power, combined with built-in Wi-Fi/Bluetooth and Deep Sleep Operating features, makes it ideal for IoT projects. The NodeMCU is powered by a Micro USB jack and a VIN pin (External Supply Pin). It has interfaces for UART, SPI, and I2C.

Arduino :- Arduino is a free and open-source platform for creating electronic projects. Arduino is made up of a physical programmable circuit board (also known as a micro-controller) and a piece of software called an IDE (Integrated Development Environment) that runs on your computer and is used to write and upload computer code to the physical board.

Raspberry Pi :- The Raspberry Pi is a low-cost, credit-card-sized computer that connects to a computer monitor or TV and operates with a standard keyboard and mouse. It is a capable little device that allows people of all ages to experiment with computing and learn to programme in languages such as Scratch and Python.

Android App (Telegram) :- The android app is used to Telegram messages, which are heavily encrypted and have the ability to self-destruct. Synced. Telegram allows you to access your conversations from multiple devices.

Acid Reflux Detector's block diagram working :-

- The pH level detector is used to detect the acidity level in the stomach, which depends upon the exchange of ions from the sample solution to the inner solution of glass electrode through the glass membrane.

- After the pH level is detected. It will send the signal to the microcontroller, and the reading will be displayed on the OLED display.
- if the value exceeds the range then the microcontroller will process the data and send the message through the Android app(telegram) to the smartphone.
- Which will alert the user about the increased acidity level and recommend the user to take the advice of the doctor for the further medication

5. Plan of work

We are aiming to complete our prototype by the end of September.

In the month of July, we will start with the literature review and detailed analysis of the project statement.

In the Month of August, we will Continue with the literature review and research on other available prototypes and our required research for the prototype and start working on the model. Initially, we will acquire all the necessary components which will be important for building the prototype. Then, we will try and figure out the final design for the prototype.

In the month of September, we might build a complete hardware setup for the acid reflux detector. After that, we will be working on the coding part which is the software part of the project. Later on, we will be configuring the hardware prototype with software setup so we can achieve proper functionality and working of the Acid Reflux Detector.

In the month of October, we will file a Patent and write the Research for the prototype.

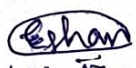
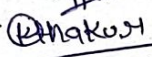
Month	Work
July	1. Literature Review 2. Detail Analysis
August	Continue with the literature review and research on another available prototype
September	1. Model Building 2. Model Testing
October	1. Research Paper

Table 1 : Month-Wise Plan

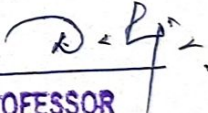
6. Reference

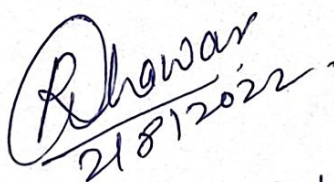
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Name and Signature of Students:

- 1. Eshan Dhakate 
- 2. Siddhant Tiwari 
- 3. Krishna Thakur 
- 4. Krish Tomar 

Name and Sign of Guide

- 1. Dr. B.M. Hardas 
- 2. Dr. Nilesh Mahajan 
PROFESSOR
DADASAHEB BALPANDE COLLEGE OF PHARMACY
BESA, NAGPUR - 440034


21/8/2022
Dr. R.S. Ochawar.
Project Coordinator
Associate Professor
Electronics Engineering
Shri Ramdeobaba College of
Engineering & Management, Nagpur-13

Department of Electronics Engineering
Shri Ramdeobaba College of
Engineering and Management, Nagpur-13