# Detecting Helicobacter pylori through a pH sensor digitally useful for early peptic ulcer diagnosis

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**Abstract -Peptic ulcers are open sores that develop on the inside lining of your stomach and the upper portion of your small intestine. In this paper, we explained about how to detect early-stage ulcers without endoscopy which is very low in cost , and targets poor people in developing and underdeveloped countries. The sensor used to detect H.Pylori bacteria cause soreness in the gastrointestinal (GI) tract. H.pylori bacteria creates acid imbalance Hence by using a pH sensor we can detect the early stage Peptic Ulcer (PU) .In the market other ulcer-detecting kits are available, but they are not digital, By using a small amount of blood we detect the ulcer.**

**Keywords — Digital pH sensor, Peptic ulcer , Helicobacter pylori .**

## I.INTRODUCTION

*1.1    What is Peptic Ulcer?*

Peptic ulcers, whether in the stomach or the duodenum, manifest as open sores in the lining of these digestive organs.These ulcers develop when the protective lining of the stomach or intestine is eroded, leading to the formation of open sores. It is more common for Helicobacter pylori (H. Pylori) to cause ulcers in the stomach. This bacterium weakens the protective mucous layer of the stomach and duodenum, making them more susceptible to damage from stomach acid.

Other factors that can contribute to the development of peptic ulcers include the long-term use of non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin or ibuprofen, excessive alcohol consumption, smoking, and stress. Peptic ulcers can cause symptoms such as abdominal pain, bloating, nausea, vomiting, and heartburn. In severe cases, complications such as bleeding, perforation of the stomach or intestine, or obstruction of the digestive tract can occur, requiring immediate medical attention.

Treatment for peptic ulcers typically involves a combination of medications to reduce stomach acid production, antibiotics to eradicate H. pylori infection if present, and lifestyle modifications such as avoiding NSAIDs and alcohol. In some cases, endoscopic procedures or surgery may be necessary to repair or remove the ulcer. With appropriate treatment and lifestyle changes, most peptic ulcers heal within a few weeks, although some may require long-term management to prevent recurrence.

*benefit of pH sensor for detecting Helicobacter pylori*:

1.1.1        pH sensors can accurately detect changes in pH levels associated with H. pylori infection, aiding in reliable diagnosis

1.1.2        pH sensors are relatively inexpensive compared to other diagnostic tools, making them accessible for screening and monitoring purposes.

1.1.3        Unlike traditional methods that require invasive procedures like endoscopy, pH sensing can be done minimally non-invasive, usually through blood samples.

1.1.4        pH sensing can provide rapid results, allowing for timely diagnosis and treatment initiation.

1.1.5        Patients may find pH sensing less uncomfortable compared to other diagnostic methods, enhancing compliance and willingness to undergo testing.

1.1.6        Due to its miniature structure of pH sensor the bacteria can detect in minimum amount of blood.

*1.2    Complex with an traditional endoscopy method*

•        Traditional endoscopy procedures carry inherent risks, including the potential for injury to the gastrointestinal tract, bleeding, perforation, or adverse reactions to sedation or anesthesia.

•        The insertion of an endoscope into the body can cause discomfort or pain for patients, particularly if the procedure requires passing through sensitive areas or if multiple attempts are needed to achieve proper

positioning.

● The insertion and manipulation of traditional endoscopes require skilled handling by healthcare professionals. Performing precise movements to reach specific areas of interest can be challenging, particularly in complex anatomical regions.

● Traditional endoscopes may encounter difficulties navigating through the digestive tract due to anatomical variations, narrow passages, and obstacles such as folds or bends in the tissue.

● For diagnosis it takes more time.

● Many traditional endoscopy procedures require sedation or anesthesia to ensure patient comfort and cooperation, adding complexity to the overall process and increasing the risk of complications associated with anesthesia administration.

## TOPIC APPROACH

The topic approach is based following major steps:
1. H.Pylori in blood
2. Miniature pH sensor
3. Current to voltage converter
4. Arduino Node MCU ,LCD
5. Testing method
6. Block Diagram
7. Final result

### 2.1 Helicobacter Pylori in blood

Presence of Helicobacter pylori bacteria in the blood.Can be detected through blood tests .

● H. pylori infection can lead to increased acidity in the stomach.This occurs due to the bacteria's ability to disrupt the stomach's protective lining, allowing stomach acid to irritate the stomach lining.

● The combination of increased acidity and disruption of the stomach lining by H. Pylori bacteria can lead
to ulcer formation.

● The bacteria can weaken the protective mucous coating of the stomach lining, making it more susceptible to damage from stomach acid.

● H. pylori infection can lead to increased production of stomach acid, which can further damage the already compromised stomach lining.

● H. pylori has been shown to disrupt the tight junctions between cells in the stomach lining, compromising the integrity of the mucosal barrier and making it more vulnerable to damage.

● Helicobacter pylori status of the individual should be known, as H. pylori infection has been shown to
increase intragastric pH readings when examining the effect of acid suppressive therapy [9] .

*Miniature pH sensor*

A diminutive pH probe designed to detect peptic ulcers provides a unique solution. Incorporating a miniaturized pH sensor tailored for ulcer detection presents an innovative method.

### 2.2 Current to voltage converter

This amount of current is converted to analog voltage using current-voltage converter .The output voltage depends on the current from test strips.

In mathematically,

$V1 = -$ (input current* feedback resistance (RF1)).

Here, V1 is negatively polarized. But microcontroller can't sense negative voltage. So voltage is inverted with unity gain .Simple but reliable op-amp inverting amplifier is used in proposed design.

The gain of this scheme depends on $Av = -RF1/R1$.

Where RF1= feedback resistance and R1= input resistance.The opted for a unity gain configuration, the input signal will be directly mirrored in the output, albeit inverted.

*2.3     Arduino Node MCU and LCD*

The Arduino Node MCU, in essence, is an Arduino-compatible micro-controller board that integrates the ESP8266 Wi-Fi module, allowing for seamless wireless connectivity and IoT capabilities. It essentially combines the functionality of Arduino and the power of the ESP8266 chip into a single, compact package.

The operation of an LCD involves a complex interplay of electrical signals, liquid crystal alignment, and optical properties to produce the desired visual output. Various techniques, such as twisted nematic (TN), in-plane switching (IPS), and vertical alignment (VA), are employed to improve viewing angles, color accuracy, and response times in LCD displays.

*2.4     Testing Methodology*

An H Pylori blood test is an easy test done using the blood sample.During this test, clean the fingertip with clean cotton ball . By using needle prick the finger tip collect one to three drop of the blood .keep it on the slide.then using a pH sensor sense the pH value and find peptic ulcer is normal or abnormal.
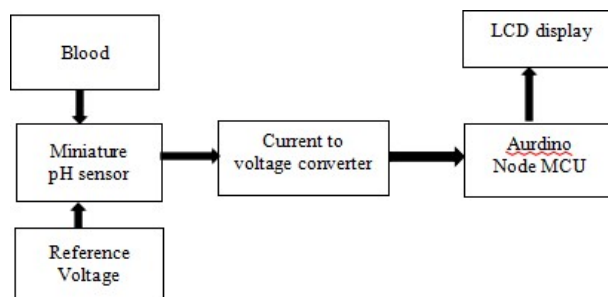
*2.5     Block diagram*



Fig:1. Block diagram of peptic ulcer detecting kit

*2.6     Final result*

The proposed ulcer kit has two main advantages over the endoscopy. These two are cost and accuracy.

*2.6.1     cost*

Compare to the endoscopy the cost is low .For taking the test endoscopy we need fees about 3000 to 3500 rupees.For this equipment one time investment you by once you can take test for multiple times.

| Components | Prices |
|---|---|
| 1.Transformer 230v | 500 |
| 2. Inventing amplifier | 450 |
| 3.Arduino Node MCU | 210 |
| 4.Miniature pH sensor | 1200 |

| | |
|---|---|
| 5.LCD Display | 250 |
| TOTAL | 2610 |

*2.6.2     Accuracy*

In market available kit are not digitalised .But our kit shows the value as digital mode.Hence the accuracy also high .

| Parameter | Values |
|---|---|
| Result Range | pH below 4 is normal pH above 4 is abnormal( which means the early stage of peptic ulcer are formed) |
| Sample Size | Approximately 5 ml of blood |
| Sample Type | Fresh capillary whole blood from the finger or forearm |
| Test Time | As little as 5 seconds |

| Result Value | Plasma calibrated |
|---|---|
| Power Supply | DC 5V |
| System Operating Range | Relative Humidity: 10 - 90% (non condensing) |
| Temperature | 50° - 104°F |

## CONCLUSION

In this paper, the main goal is to design and implement a very low cost with greater accuracy ulcer testing kit than the conventional one. The hardware and software features of a Arduino node MCU based system for the measurement of ulcer are described. The necessary software is developed in C programming, using AVR studio. The system is quite successful for the measurement of ulcer with an accuracy of around 93% which is far better than conventional meters. The cost is extremely low compared with over the endoscopy so that it can be beneficiary for the developing countries . If the proposed meter is marketed by any industry, millions of people in developing and underdeveloped country will be benefited. It is pain less technique also.

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