

## **DESIGN & DEVELOPMENT OF A LOW-COST DIAGNOSTIC TOOL TO DETECT GASTROPATHOLOGY CONSIDERING ELECTROGASTROGRAM**

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**Abstract** - Electrogastrogram is the recording the abdominal myo-electrical activity. This technique is referred to as Electrogastrography. However, the electrical activities in the gastric region depend on various reasons so making it quite difficult to obtain the exact record. Theoretically, it is said that the contrast between the normal and pathological condition can be observed by a good margin. So even if it cannot produce an exact record for accurate diagnostic result, it can be used to detect whether a diagnosis is required or not. In this present work we have designed an indigenous kit for identification of the gastro pathological like ulceration, gastritis, acid reflux, detection of barrett, etc just to name a few considering the electrogastrogram so that is can serve as a cost-effective diagnostic tool for further medical intervention. The interest is mainly because of the non-invasiveness and simplicity of this method as compared to the other well established medical techniques. The painful endoscopic procedures involving patients endurance of pain has deeply motivated us with the need of a painless technique for the diagnostic treatment.

**Keywords:** gastropathology; electrogastrogram; gastrointestinal activity; abdominal myoelectric activity;

## INTRODUCTION

Electrogastrography was invented earlier but it became quite popular in the nineties. It has been able to grasp a good amount of awareness of the medical practitioners and researches due to its non-invasive nature in spite of subsequent concerns and controversies that have risen over time. Application of Electrogastrography in evaluating normal gastric myo-electrical activity as well as abnormal gastric myo-electrical activity and the relative gastric motility dysfunction has got phenomenal medical significance. These signals are obtained non-invasively through surface electrodes interfaced with the abdomen and are called Cutaneous Electrogastrography (EGG). A blending of two types of motion is significant- one is the movement of the heart and the other one is muscular movement (slow wave patterns indicating 3 cycles of stomach in one minute).

Pharmaceuticals which instigate a vomiting tendency have massive effects on the stomach. Hence, it is extremely strenuous to filter slow wave patterns digitally in order to reach any conclusion for the objectives. Electrogastrography is a parameter depicting the entire slow waves of the stomach. For a normal subject the standard cycle is 3 cycles of stomach per minute. For subjects with brady-gastria and tachy-gastria it is 0.5 to 2 cycles per minute and 5-7 cycles per minute respectively. Patients having gastric motility disorder have electrogram showing increased tachy-gastria. [1-4] Ectopic nature is visible in case of dysrhythmia. Gastric dysrhythmia can also be measured by electrogram just like that of internal serosal reading and has been proved to be inter-connected with gastric hypo-motility or impaired gastric contractions. Jolts with enormous effects are observed for long period of fasting. Works of many researchers have stated about well established associations of electrogram with gastric contractile activities. [5-6] For patients suffering from gastrointestinal motility disorders or functional gastrointestinal diseases, the electrogram is basically used for recognizing patho-

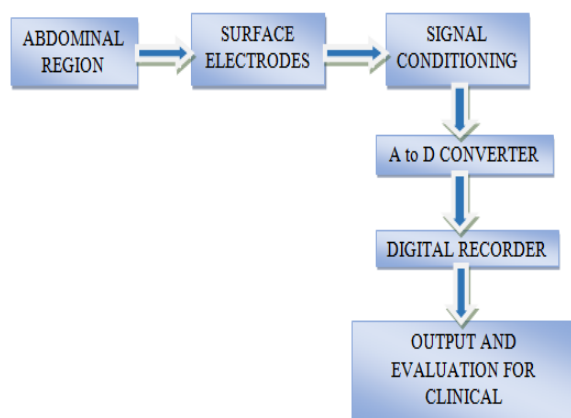
physiology of the diseases which are linked with gastric slow waves or dysrhythmia. Abnormalities in EGG are most commonly seen in patients suffering from gastroparesis. The flaws are decreased number of slow waves, increased gastric dysrhythmia and reduced postprandial electrogram ruling power. Gastric dysrhythmia is also found to be very frequent in patients with undefined vomiting and nausea. It is also largely visible in patients with early pregnancy. However, a direct association between gastric dysrhythmia with nausea and vomiting has rarely been proved. [7-10] The Electrogram obtained from subjects often determinedly varies based on the gastro-pathological condition they're suffering from. From the studies it has been noted that subjects with any kind of abdominal malignancy irrespective of the exact affected area reflect an abnormal EGG in the postprandial as well as pre-prandial state. Subjects suffering from colon cancer, rectal cancer or gastric cancer show less normo-gastria time and high dominant power in fasting state and even after a meal. Beside this there exists a direct association between bloating with pre-prandial brady-gastria in all such patients.[11] In case of infants suffering from dyspepsia- a condition of discomfort in the upper abdomen characterized by various symptoms like vomiting, nausea, feeling of fullness etc., it is seen that their electrogram represents a decreased postprandial amplitude increase coupled with an increased tachy-gastria.[12,13] Adults suffering from anorexia nervosa- a condition defined as a mental condition where the affected individual refuses to eat obsessing over low body weight, show an increased abnormality in the electrogram. Children however do not express any such changes in their EGG despite of being a patient of acute anorexia nervosa.[14,15] Studies also revealed that GERD (Gastroesophageal Reflux Disease) patients show an abnormality in their EGG characterized by myoelectric abnormalities.[16]

## MATERIALS & METHODOLOGY

### A. DATASETS

Electrogastrography is a non-invasive method of recording the myo-electrical activity of the stomach using surface electrodes placed on three standard locations on the abdomen. It is a very simple method with a lot of clinical significance due to its efficiency in providing the pictures for a large range of gastro pathological conditions. We have used the data from 35 consenting adult volunteers of the age group 20-65 years in three conditions Fasting, Postprandial and various gastro pathological conditions. For the process of acquisition of the EGG Signal from the subject, they are advised to remain in supine position on the patient table. The surface electrodes are placed on three standard positions of the electrodes for obtaining accurate gastric signals. The electrode gel facilitates the firm contact of the surface Ag/AgCl electrodes with the skin on the stomach region so that no motion artefact can arise and disrupt the original gastric signal. For acquiring “fasting” signals, the subject is asked to stay empty stomach for a span of 8 or 12 hours prior to the process. And for acquiring “postprandial” signals, the recording is taken after half an hour of a meal.

### B. FLOW-CHART FOR THE SET UP



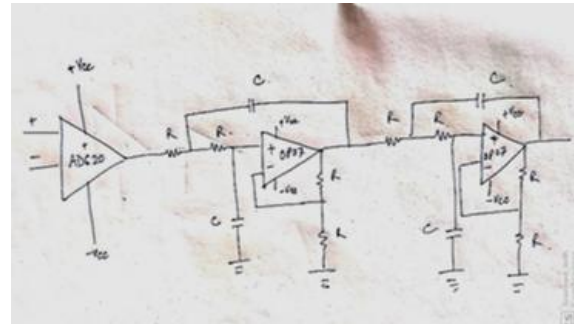
**Fig1: System flowchart**

The entire workflow comprises of the major phases like raw signal acquisition, pre-processing, feature detection leading to identification of different wave patterns caused

due to gastrointestinal activity & gastropathology.

### C. HARDWARE IMPLEMENTATION

For designing our prototype, we have used some basic circuit components like instrumentation amplifier IC, op-amp, resistors, capacitors, connecting wires, Ag/AgCl electrodes, batteries, connectors, DSO etc.

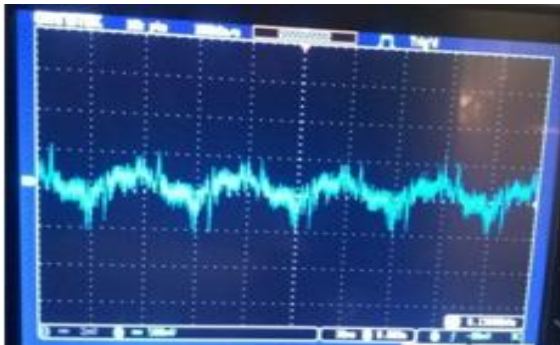


**Fig2: EGG signal acquiring circuit**

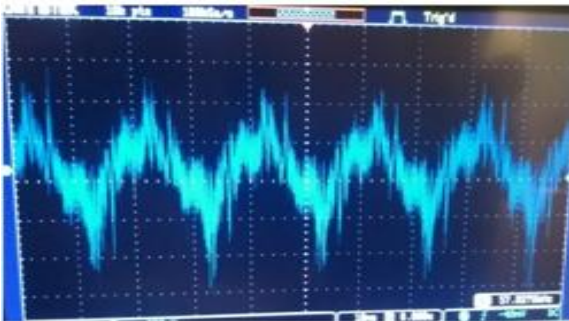
The electrodes are interfaced with the stomach i.e abdominal region of the subject. Since the gastric signals are feeble and of very low frequency they need to undergo proper conditioning so that accurate data can be obtained from them. The first stage consists of connecting the electrodes connected to IC to amplify very weak signals of very low amplitude. A gain of 1000 was provided to attain maximum possible gain for a 50 microvolt signal. The second stage is done for filtering where an active low pass filter is designed with OP07 IC and a two poles Bessel filter is made connecting capacitors and resistors combined in the non inverting configuration to give a gain of two. In the third stage of implementation, the arrangement of the second stage is repeated to design a four pole, sixth order Bessel filter according to Texas Instruments Design. The signals once conditioned and processed are digitally recorded using a digital recorder. And finally the processed data are utilized for viewing using a software interface with the computer system for further clinical examination.

## RESULTS

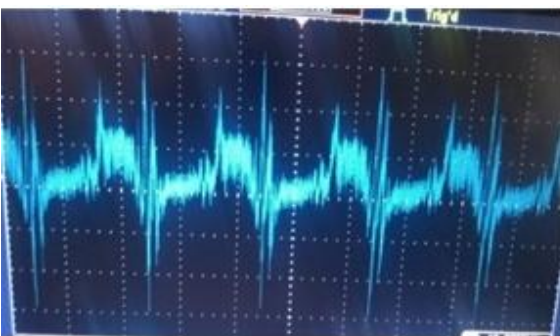
EKG signals have been acquired from different subjects of different age groups with different physiology. The signals thus obtained are not similar, variations are prominent. Nevertheless there's concrete evidence that the frequency and amplitude of gastric motility drastically increases after consumption of food. For subjects having vertigo, gastric movement is ectopic in nature which implies anti-peristaltic movement.



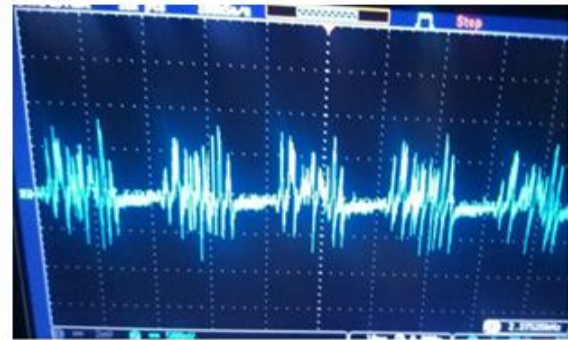
**Fig3a:** Signal obtained after 8 hours fasting



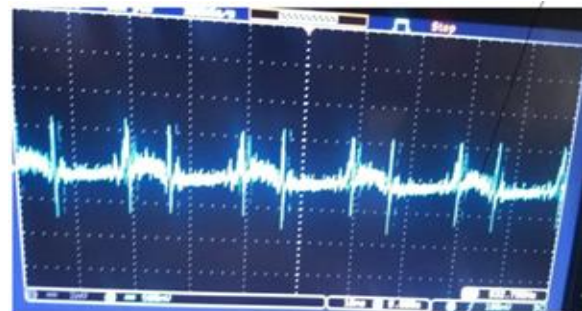
**Fig3b:** Signal obtained after 8 hours fast broken



**Fig3c:** Signal obtained after 12 hours fast broken



**Fig3d:** Signal taken in gastritis condition after ingestion of 3 full glass of water



**Fig3e:** Signal taken with acidity-vertigo

## CONCLUSION

Over the years it has been revealed that even though EKG has a massive potential in clinical diagnosis, it still yields enormous doubts and scope for exploration at the same time. Gastro myo-electric signals obtained for different gastro pathological conditions are diverse in nature and characteristically distinct from each other. We've collected the data from subjects on the basis of three distinct conditions. It is a great diagnostic tool for the detection of variations in electrogastragram depending upon gastro pathological conditions like any kind of anorexia nervosa, dyspepsia, acidity vertigo, gastritis etc. Our study has been performed on 35 consenting volunteers. The main motive of our work is to enhance gastric conditions analysis through the use of myoelectric activity of the stomach. There's concrete evidence through the results that the frequency and amplitude of gastric motility drastically increases after consumption of food. As of now, with this we can identify whether serious medical intervention is further required or not for the subjects. For subjects with vertigo, ectopic nature is observed in the

gastric movement. It can be used for evolving a monitoring system that would easily pin-point subjects having internal stomach bleeding as it can clearly be indicated by a decrease in slow wave patterns. With further development, it can act as a direct substitute for painful, highly discomforting invasive procedure like endoscopy.

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