

Development of Etch Surface on Eus Needle

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Abstract- The etch surface on Endoscopic Ultra Sound needle is a challenging technology in the medical sector. It has been developed through Gelasin making automated tool. This tool has been designed through Arduino microcontroller, Relay board, SMPS board, 12V DC motor. Etch surface on the needle helps to obtain the detailed images of the abnormal area, if the images are not clear and location of the abnormal area is not accurate etch surface on the needle emits the sound waves to get clear images. Each diameter 0.1mm has achieved on the 0.17mm EUS needle. The entire process of GMAT has been controlled by HC05 Bluetooth module. Etch surface on EUS needle has been tested and functioning.

Keywords: EUS needle, GMAT, AMC, Relay board, Bluetooth module.

I. INTRODUCTION

Endoscopic ultrasound is a medical procedure in which endoscopy (insertion of a probe into a hollow organ) is combined with ultrasound to obtain images of the internal organs of the chest, abdomen and colon. It mainly is used to visualize the walls of these organs and adjacent structures. Combined with Doppler imaging, nearby blood vessels can also be evaluated. Endoscopic ultrasonography is most commonly used in the upper digestive tract [1]. The endoscopic procedure has been shown in Fig 1. For the patient, the procedure feels almost identical to the endoscopic procedure without the ultrasound part, unless ultrasound-guided biopsy of deeper structures is performed. It allows for screening for pancreatic cancer, esophageal cancer, and gastric cancer, as well as benign tumors of the upper gastrointestinal tract. It also allows for characterization and biopsy of any focal lesions found in the upper gastrointestinal tract, such as esophageal tuberculosis. This is done by inserting a needle through the stomach lining into the target. This procedure is used to identify

malformations and masses in the bile ducts and pancreatic ducts.

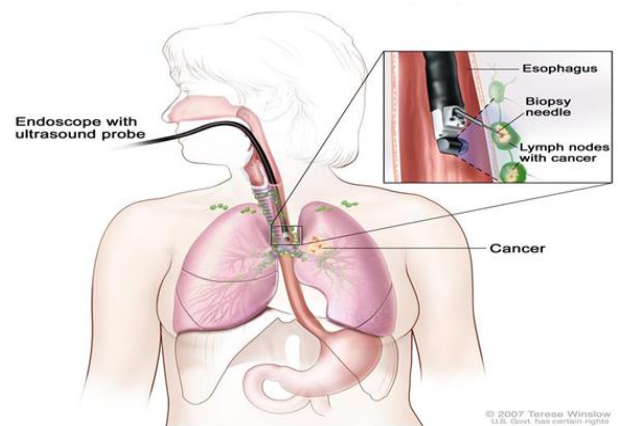


Fig 1. Endoscopic Ultrasound [2].

II. PRODUCT DEVELOPMENT PROCESS

New product development is a task taken by the company to introduce newer products in the market. Regularly there will arise a need in the business for new product development. Customers existing products may be technologically outdated, organization have different segments to target cannibalize an existing product [2]. In such cases, new product development is the answer for the company. Product development process has been shown in Fig 2. There are several stages of new product development process and they are as follows.

Idea generation: Organizations basically involved in the systematic search for new product Ideas. Searches for product ideas that meet company objectives. An organization has to generate many ideas in order to find one that is worth pursuing. The Major sources of new product ideas include internal sources, customers, competitors, distributors and suppliers.

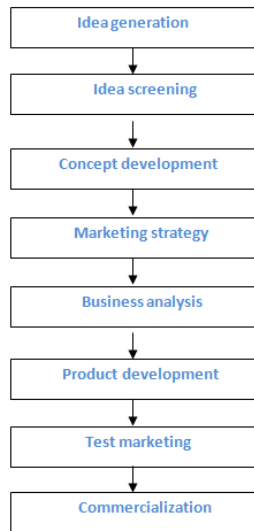


Fig 2. Product development process [2].

Idea screening: The purpose of idea generation is to create a large pool of ideas. The purpose of this stage is to pare these down to those that are genuinely worth pursuing. Companies have different methods for doing this from product review committees to formal research. It is helpful at this stage to have a checklist that can be used to rate each idea based on the factors required for successfully launching the product in the marketplace and their relative importance.

Concept development and testing: An attractive idea has to be developed into a Product concept. Once the concepts are developed, these need to be tested with consumers either symbolically or physically.

Marketing strategy development: This is the next step in new product development. The strategy statement consists of three parts: the first part describes the target market, the planned product positioning and the sales, market share and profit goals for the first few years. The second part outlines the product's planned price, distribution, and marketing budget for the first year. The third part of the marketing strategy statement describes the planned long-run sales, profit goals, and the marketing mix strategy.

Product development: Organization develops the product concept into a physical product. This step calls

for a large investment. It will show whether the product idea can be developed into a full-fledged workable product. Organization will develop prototypes that will satisfy and excite customers and that can be produced quickly and at budgeted costs.

Test marketing: If the product passes the functional tests, the next step is test marketing. The stage at which the product and the marketing program are introduced to more realistic market settings. Test marketing gives the marketer an opportunity to tweak the marketing mix before the going into the expense of a product launch. The amount of test marketing varies with the type of product.

Commercialization: The final step in new product development is Commercialization. Introducing the product to the market it will face high costs for manufacturing and advertising and promotion. The company will have to decide on the timing of the launch (seasonality) and the location (whether regional, national or international). This depends a lot on the ability of the company to bear risk and the reach of its network.

III. DESIGN AND DEVELOPMENT PROCESS OF GMAT

Design refers to those activities involved in creating the styling, look and feel of the product, deciding on the product's mechanical architecture, selecting materials and processes, and engineering the various components necessary to make the product work.

Conceptual Design: It is an early phase of the design process, in which the broad outlines of function and form of are articulated. It includes the design of interactions, experiences, processes and strategies. It involves an understanding of people's needs - and how to meet them with products, services, & processes. The task of developing outstanding new products is difficult, time-consuming, and costly. People who have never been involved in a development effort are astounded by the amount of time and money that goes into a new product. The conceptual design of the GMAT has been shown in Fig 3. Great products are not simply designed, but instead they evolve over time through countless hours of research, analysis, design studies, engineering and prototyping efforts, and

finally, testing, modifying, and re-testing until the design has been perfected.

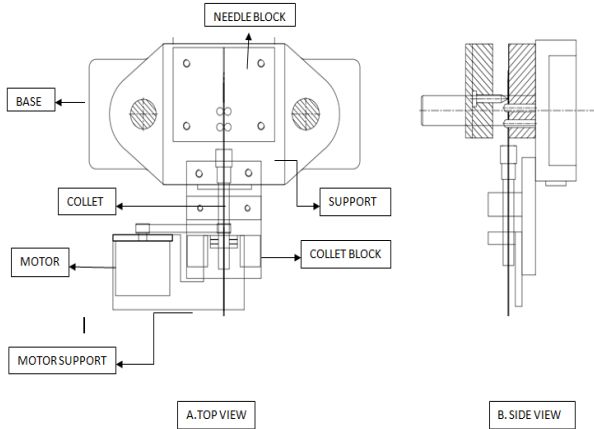


Fig 3. Conceptual Design of GMAT.

System Level Design: Computer-aided design (CAD) is the use of computer systems (or workstations) to aid in the creation, modification, analysis, or optimization of a design. The CAD mode of GMAT has been shown in Fig 4. Software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing.

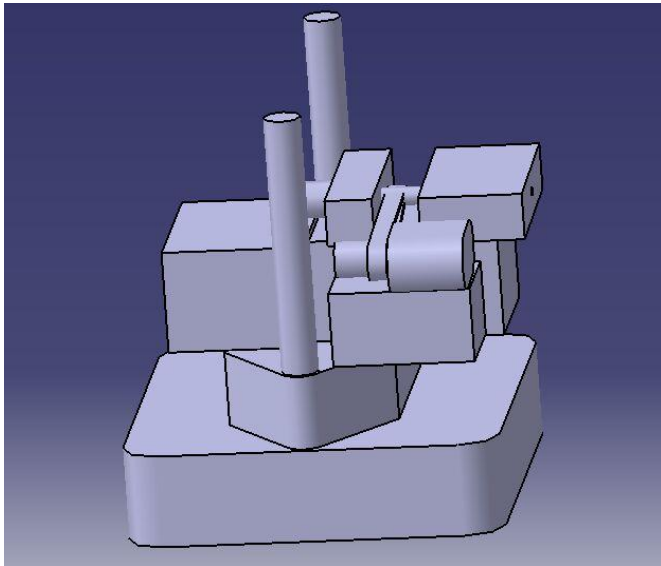


Fig 4. CAD model of GMAT.

Detail Design: The GMAT mainly consists of the Base, needle block, vertical support, collet, collet support. The material used for GMAT is mild steel. Tool of the GMAT is made up with the Die-steel-EN31 high carbon alloy steel, which has high strength and corrosion resistance. During this phase, each part is identified and engineered. The assembly model of EUS has been shown in Fig 5. Three-dimensional computer models form the core of today's rapid prototyping and rapid manufacturing technologies.

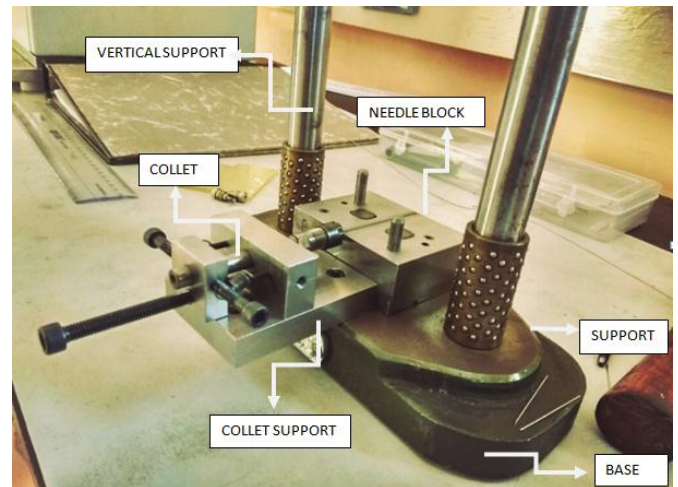


Fig 5. Assembly of GMAT.

IV. AUTOMATION PROCESS OF GMAT

Industrial automation deals primarily with the automation of manufacturing, quality control and material handling processes. General purpose controllers for industrial processes include Programmable logic controllers, stand-alone I/O modules, and computers [5]. Industrial automation is to replace the decision making of humans and manual command-response activities with the use of mechanized equipment and logical programming commands. The process of automating the GMAT involves the Arduino programming and microcontroller, which controls the every sequence of operation. The following are the components used in automation process of GMAT.

Arduino Microcontroller: Arduino is an open source, computer hardware and software Company, and user single board microcontrollers and microcontroller kits

for building digital devices and interactive objects that can sense and control objects in the physical world. The Arduino microcontroller has been shown in Fig 6. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.



Fig 6. Arduino microcontroller [5].

Motors: A motor is an electrical machine that converts electrical energy into mechanical energy. The reverse of this is the conversion of mechanical energy into electrical energy and is done by a generator. The 12v dc motor has been showed in Fig 7. In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. In certain applications, such as in the transportation industry with traction motors, electric motors can operate in both motoring and generating or braking modes to also produce electrical energy from mechanical energy.



Fig 7. 12v DC motor [5].

A switched-mode power supply: A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Switch mode power supply board has been shown in Fig 8. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer while converting voltage and current characteristics.



Fig 8. SMPS board [5].

Relay board: A relay is an electromagnet to mechanically operate a switch but other operating principles are also used, such as solid-state relays. The 8 channel relay board has been shown in Fig 9. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor.

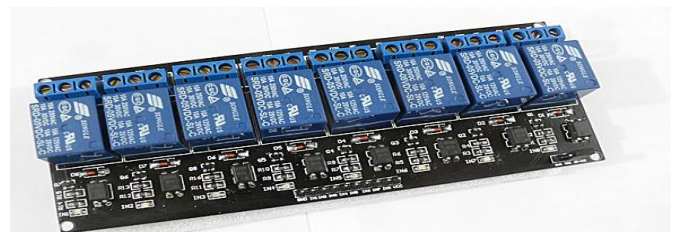


Fig 9. 8 channel relay board [5].

Bluetooth Model: Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). The Bluetooth module HC05 has been shown in Fig 10. Bluetooth operates at frequencies between 2402 and 2480 MHz, or 2400 and 2483.5 MHz including guard bands 2 MHz wide at the bottom end and 3.5 MHz wide at the top.

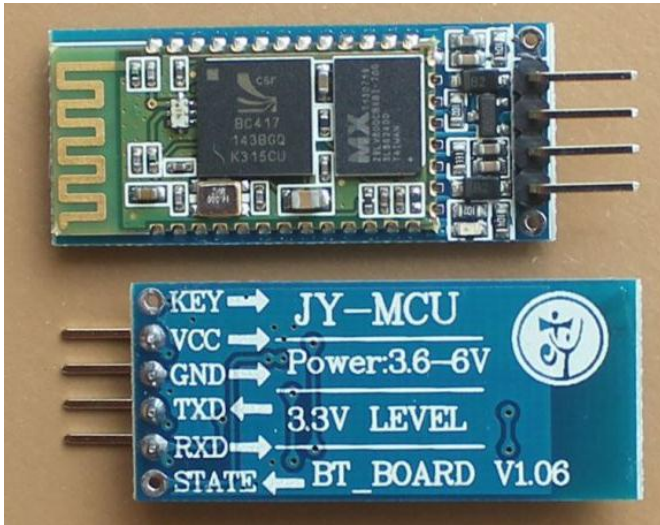


Fig 10. Bluetooth module [5].

V. WORKING MODEL OF GMAT

The working model of the GMAT mainly consists of Arduino microcontroller, relay, SMPS, Bluetooth module and motors. The working model of GMAT indicates linear and angular motion of the GMAT. The working model of GMAT has been shown in Fig 11. The working model of the GMAT is controlled with the help of Bluetooth module.

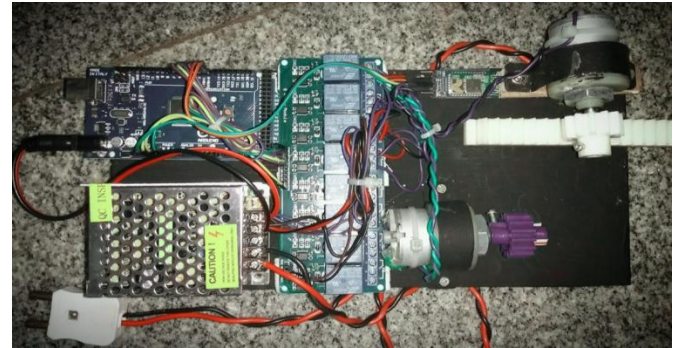


Fig 11. working model of GMAT.

VI. TESTING

Etch surface on the EUS needle has been tested with the help of the video measuring system. The following tests are carried out in the VCS machine. The diameter of the EUS needle is 0.17mm and diameter of etch point is 0.1mm. The distance between one etch point to another point 0.15mm. The angle between etch points 20degree. The outside etch surface does not affect the inside diameter of the needle. The pattern of the etch points. . The result of the etch points are accurate and have attractive pattern as per given condition. Video coordinate measurement machines are specifically designed for non-contact measurement and inspection of small intricate features on small or large parts. These video measurement systems are a natural step up from measuring microscopes and optical comparators. The video coordinate system has been showed in Fig 12. The tested pattern of EUS needle has been shown in Fig 13, 14. With granite base construction and steel stages provide long term accuracy and reliability.

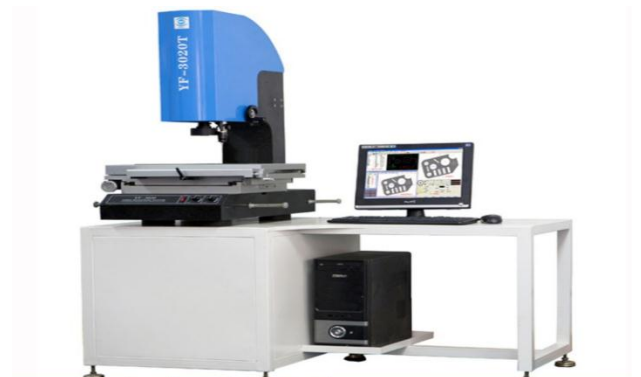


Fig 12. Video measuring system.

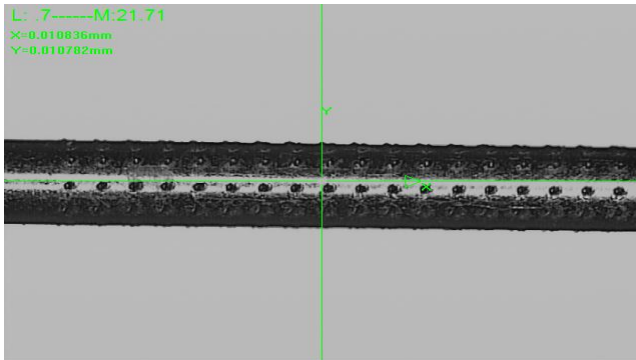


Fig 13. Tested pattern of EUS needle.

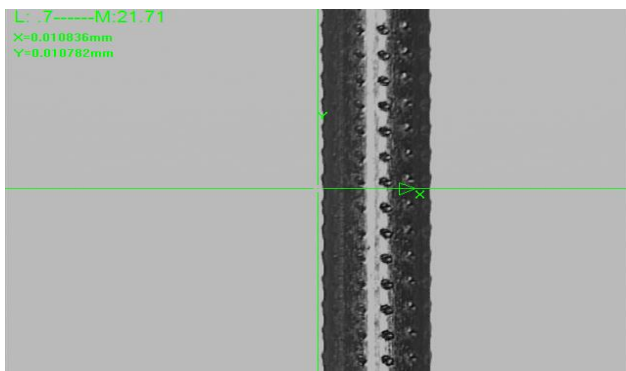


Fig 14. Tested pattern of EUS needle.

VII. CONCLUSION

Etch surface on EUS needle has been developed through GMAT. The developed EUS tool which is an automated and totally controlled by Bluetooth. The etch surface has been observed on VMS machine. The diameter of the needle is 0.17mm, the diameter of etch points are 0.1mm. The distance between one etch point to another etch point is 0.15mm. The angle between etch points are 20degree. As per the measured dimension it is possible to emit the more sound waves from the needle which helps the doctor to monitor abnormal endoscopic area.

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