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Analyzing the Characteristics of Biodegradable Stent in Labview

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Abstract

Heart health is important for the overall normal function of the body. Given the complexity of all heart diseases, especially when each person's experience is different, there are various options to help a patient become healthier. This MQP examines the effectiveness of several cardiac solutions to determine the best solutions for patients. Our primary focus is on the evolution of stents and a comparison of the commonly used stents to other surgical options. LABVIEW software plays a major role in identifying the quality of the stent at different stages. The real time image of the stent is acquired using Vision Acquisition tool in LABVIEW and then it is processed using Vision assistant tool. Pattern matching algorithm is used for detecting the defects in the stent. GSM technology is used for sending the output result to the corresponding end client. Image processing is implemented using LABVIEW and GSM based SMS alert will be send to the patient and doctor about the stent characteristics.

Keywords: Biodegradable Stent, Zinc and Austhentic Stainless Steel, LABVIEW analysis, GSM.

Introduction

Cardiovascular disease continues to be the leading cause of mortality, with a vast majority of these deaths attributed to obstructive coronary artery disease (CAD). Depending on the severity of the disease, the main interventional options for revascularization include angioplasty, stent deployment and in severe, diffuse occlusions (more than 70%), bypass graft surgery. Narrowed coronary arteries were originally treated percutaneous with balloon angioplasty alone. However, clinical complications including abrupt vessel closure from elastic recoil in the short term and significant neointimal hyperplasia, limited the applicability of this intervention. Improved results were observed following the insertion of an additional intravascular mechanical support, cylindrical metal scaffolds known as stents. The first balloon expandable stents were designed from surgical grade stainless steel, and aimed to provide additional mechanical support, limiting vessel recoil and preventing acute occlusion. The high rates of restenosis for bare metal stents are a significant drawback in their clinical application. Preliminary drug-coated stents were engineered with surface anticoagulants, such as heparin or warfarin to prevent sub-acute thrombosis and bleeding complications.

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Bioabsorbable Stents

Bioabsorbable stents are proposed to solve the problem of long-term stent biocompatibility by degrading over time. The first bioabsorbable, balloon expandable stents implanted in humans were constructed from poly-L-lactic acid (PLLA). The bonds between the repeating lactide units of the bioabsorbable stent hydrolyze to produce lactic acid, metabolized to CO_2 and H_2O. Absorption occurs via bulk erosion throughout the implant not just on the surface, allowing the stent strut to retain its shape, until the process is well advanced. The Abbott Vascular bioabsorbable vascular scaffold (BVS), a PLLA stent, has so far demonstrated restenosis similar to bare metal platforms, as well as late scaffold shrinkage and non-uniform vessel support, due to uneven scaffold degradation. Alloys of magnesium have also been explored as bioabsorbable stent platforms. Absorption by surface erosion reduces the strut thickness as the stent is absorbed, within 4 months of implantation, leading to loss of radial support. The latest generation bioabsorbable stents are designed for prolonged radial support coupled with drug elution. A number of different materials have been utilized to manufacture these stents ranging from metal alloys to a variety of polymers, including tyrosine-derived polycarbonate polymer, salicylate and a linker, as well as metal-cobalt chromium with n-butyl methacrylate coating. The Bio Matrix stent incorporates the thin S-stent platform with a reduced percentage metal surface area (16.3%–18.4%) to elute the anti-proliferative drug biolimus A9; a highly lipophilic semi-synthetic analogue of sirolimus. Furthermore, the stent is completely bioabsorbable degrading in vivo to lactic acid in 6–9

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months post implantation. The JACTAX stent (Boston Scientific Corporation, Natick, MA, USA) was designed on similar principles, coated with an ultra-thin, mixture of biodegradable PLLA and paclitaxel drug applied as microdots, per 16-mm stent. The stents were comparable to the preceding paclitaxel eluting stent, although further studies are underway to evaluate their potential for improved vessel healing.

LabView Software

LABVIEW is highly productive development environment for creating custom applications that interact with real-world data or signals in fields such as science and engineering. It is different from traditional programming like VB, C#, Maple, MATLAB, MathScript, etc. It is more like a "drawing program" than a programming language. This makes it easy to use for non-programmers. LABVIEW has the flexibility of a programming language combined with built-in tools designed specifically for test, measurement, and control. The advantage of LABVIEW lies in its ability to quickly facilitate taking measurements.

Software Description

LABVIEW differs from most other development platforms in the regard that it depends on 'visual programming' more than actual coding. The language used in LABVIEW is also called 'G', which is completely different from the numeric control programming language G-code or G programming language. G is a dataflow programming language, which means that it models its programs on directed paths. It is a highly versatile programming language that reflects changes in real time, suitable for real world applications.

Basics of

LABVIEW

The block diagram contains the graphical source code of a LABVIEW program. The concept of the block diagram is to separate the graphical source code from the user interface in a logical and simple manner. Front panel objects appear as terminals on the block diagram

Front Panel

When you open a new or existing VI, the front panel window of the VI appears. The front panel window is the user interface for the VI.

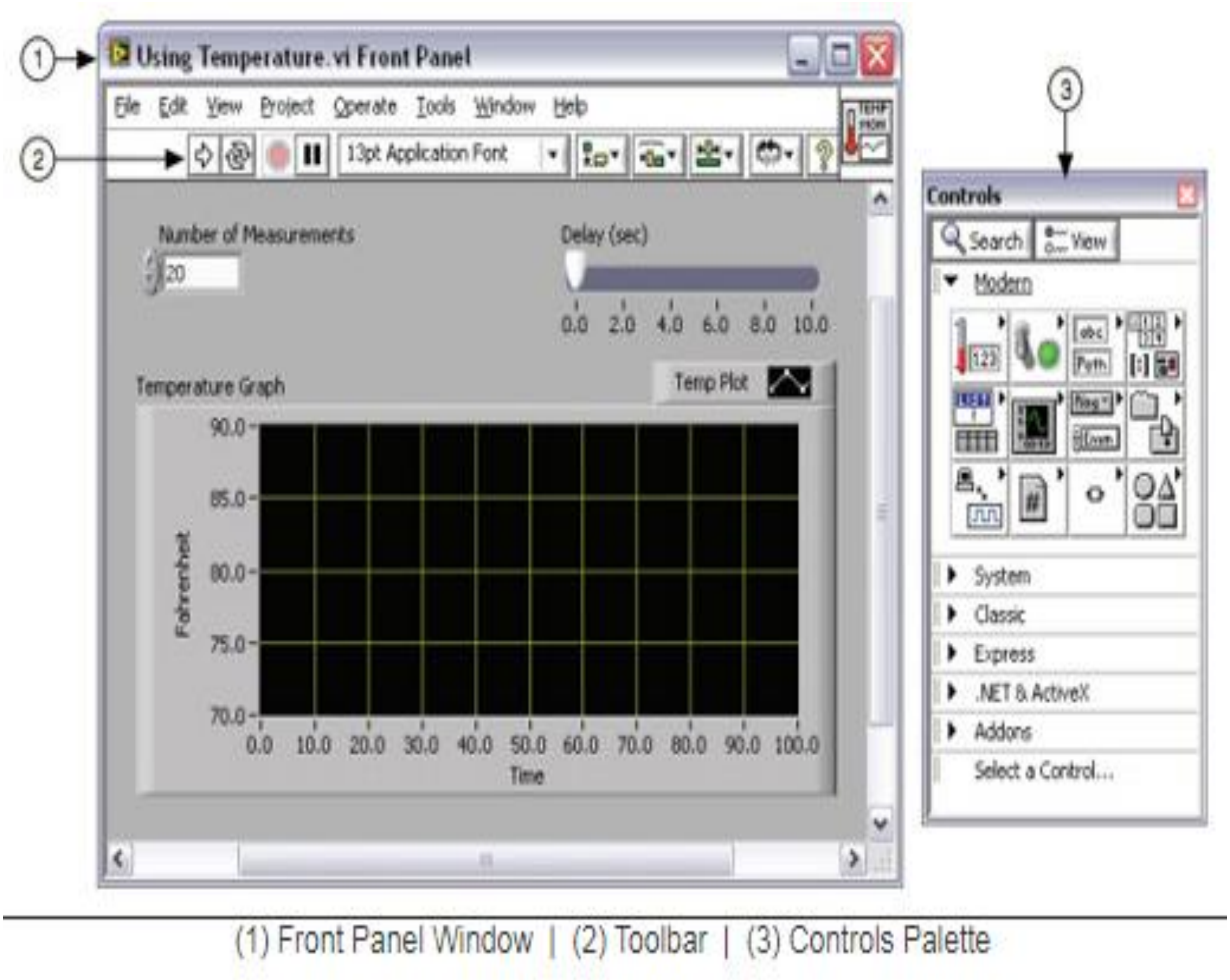

Figure I. Front Panel of LABVIEW

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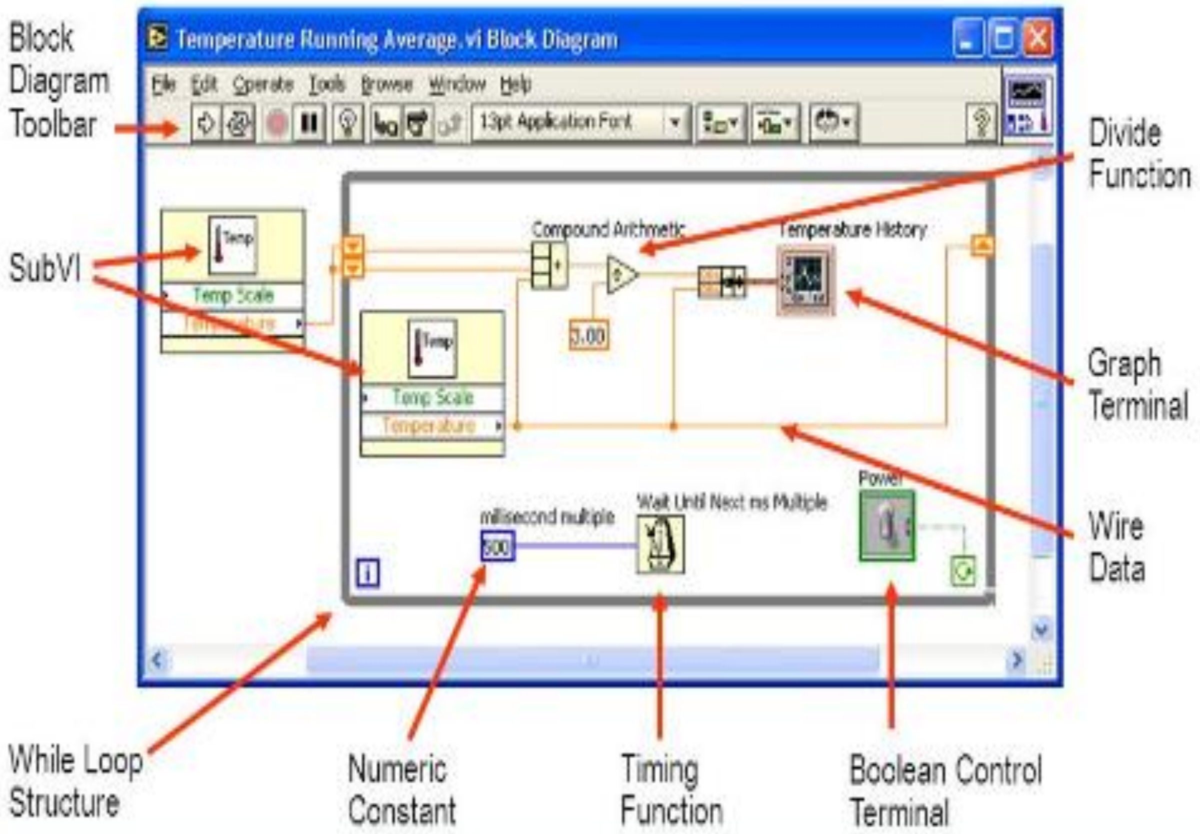

Figure II. Temperature Running Block Diagram

Controls Palette

The Controls palette contains the controls and indicators you use to create the front panel.

Boolean Controls and Indicators

The Boolean data type represents data that has only two possible states, such as TRUE and FALSE or ON and OFF. Use Boolean controls and indicators to enter and display Boolean values. Boolean objects simulate switches, push buttons, and LEDs.

Figure III. Boolean Indicator

After you build a VI, you can use it in another VI. A VI called from the block diagram of another VI is called a sub VI. You can reuse a sub VI in other VI's. To create a sub VI, you need to build a connector pane and

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create an icon.

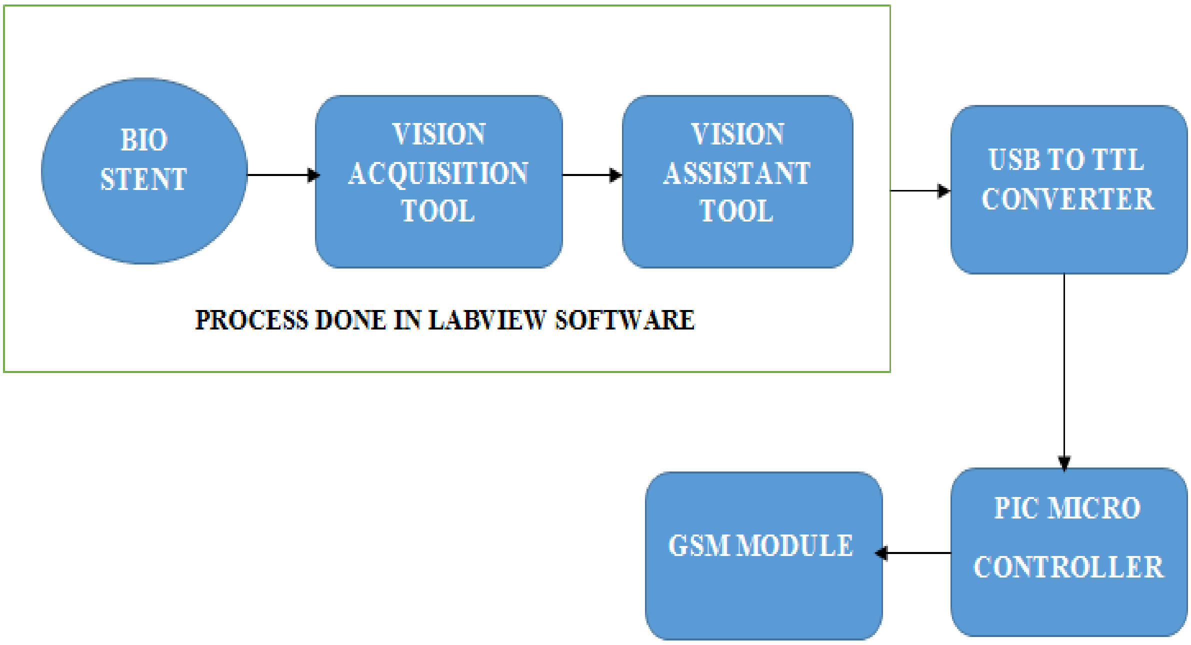
A sub VI node corresponds to a subroutine call in text-based programming languages.

IMAQ Image control-This control is the type definition that describes the image data type.

GSM:

GSM, which stands for Global System for Mobile communications, reigns as the world's most widely used cell phone technology. Cell phones use a cell phone service carrier's GSM network by searching for cell phone towers in the nearby area.

Working



Biodegradable stent images are analyzed and compared in LABVIEW software. Image display- This control is used to create Region of Interest (ROI). Classic and 3D images are available in this control panel.

Machine vision-

- Coordinate System
- Count and Measure Objects
- Measure Intensities
- Measure Distances
- Locate Edges
- Find Pattern

The techniques used for analysis are pattern matching, geometric matching, edge detection and color location the combination of these technic will give as the analysis output of material, quality, flexibility, rust, temperature and other properties of bio degradable stent image the analysis output is sent to pic microcontroller serial through visa tool (virtual instrumentation serial access).

Different biodegradable stent images were acquired by vision acquisition tool and the images were processed by vision assistant tool in LABVIEW software. The USB TTL serial cables provide connectivity between USB and UATR interfaces. Through TTL cable the processed images are transmitted to the corresponding person via GSM module.

Results and Conclusion

Our system is to provide technology trends and information regarding market and prospects in stents used for human blood vessels in Korea and the world. A stent is a medical device in the form of a cylindrical metal net used to normalize flow when blood or other bodily fluids such as biliary fluids are obstructed in blood vessels, gastrointestinal tracts, etc. by inserting the stent into a narrowed or clogged area. Stents are classified into vascular and non-vascular stents. The coronary artery stent is avascular stent that is used for coronary atherosclerosis. The demand is increasing for stents to treat diseases such as those affecting the heart and blood vessels of elderly and middle-aged patients. Due to the current shift in the demographic structure caused by an aging society, the prospect for stents seems to be very bright. The use of a stent designed to prevent acute vascular occlusion and restenosis, which is a side effect of conventional balloon angioplasty, has rapidly become popular because it can prevent acute complications and improve clinical outcomes. Since the initial release of this stent, there have been significant developments in its design, the most notable of which

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has been the introduction of drug-eluting stents (DES). Bioresorbable scaffolds (BRS) have the potential to introduce a paradigm shift in interventional cardiology, a true anatomical and functional "vascular restoration" instead of an artificial stiff tube encased by a persistent metallic foreign body.

Improving Human Health with Biomedical Stents

One common treatment for atherosclerosis is a procedure called *percutaneous transluminal angioplasty*, which removes or compresses unwanted plaque that has built up in a patient's coronary artery. This procedure sometimes relies on stents, placed within a blocked artery by an angioplasty balloon.

After reaching the intended location, the balloon inflates the stent, which locks into an expanded position. The balloon is then deflated and removed, while the stent remains in the artery. The expanded stent functions like a scaffold, keeping the blood vessel open and enabling blood to flow normally. Of course, for the angioplasty procedure to be a success, the tools used must perform as intended. If the ends of the stent expand more than its middle — a common defect known as *dogboning* the artery can face serious damage. Another potential issue is *foreshortening*, which makes it challenging to position the stent and can also damage the artery.

The results of experimental implantation of Zinc and its alloys constitute the new generation of biodegradable metallic materials for biomedical implants. Biodegradable implants of Zn, customized for the specific patient can be potentially realized through additive manufacturing processes. However, Zn is characterized by low melting and boiling points, resulting in high porosity in the build parts. In this work, the selective laser melting (SLM) of pure Zn powder is studied to improve part density. A flexible prototype SLM system was used to determine process feasibility under different atmospheric conditions. Working in a closed chamber under inert gas was found to be inadequate. Process stability was obtained in an open chamber with an inert gas jet flow over the powder bed. The effect of laser process parameters and powder size was studied in this condition. Part density over 99% was achieved in optimal processing conditions.

Serial No	Material	Characteristics	Test value
1	Austenitic 316 Stainless Steel	Longavity Corrosion Resistance Strength Flexibility	100% 100% 100% 90%
2	Austenitic 316 Stainless Steel (dissolve)	Longavity Corrosion Resistance Strength Flexibility	80% 60% 80% 70%
3	Austenitic 316 Stainless Steel (rust)	Longavity Corrosion Resistance Strength Flexibility	80% 80% 90% 70%
4	Zinc Alloy	Longavity Corrosion Resistance Strength Flexibility	100% 100% 100% 100%
5	Zinc Alloy (dissolve)	Longavity Corrosion Resistance Strength Flexibility	50% 50% 60% 40%
6	Zinc Alloy (rust)	Longavity Corrosion Resistance Strength Flexibility	50% 50% 60% 40%

Table 1. *Comparison between material Zinc and Stainless Steel*

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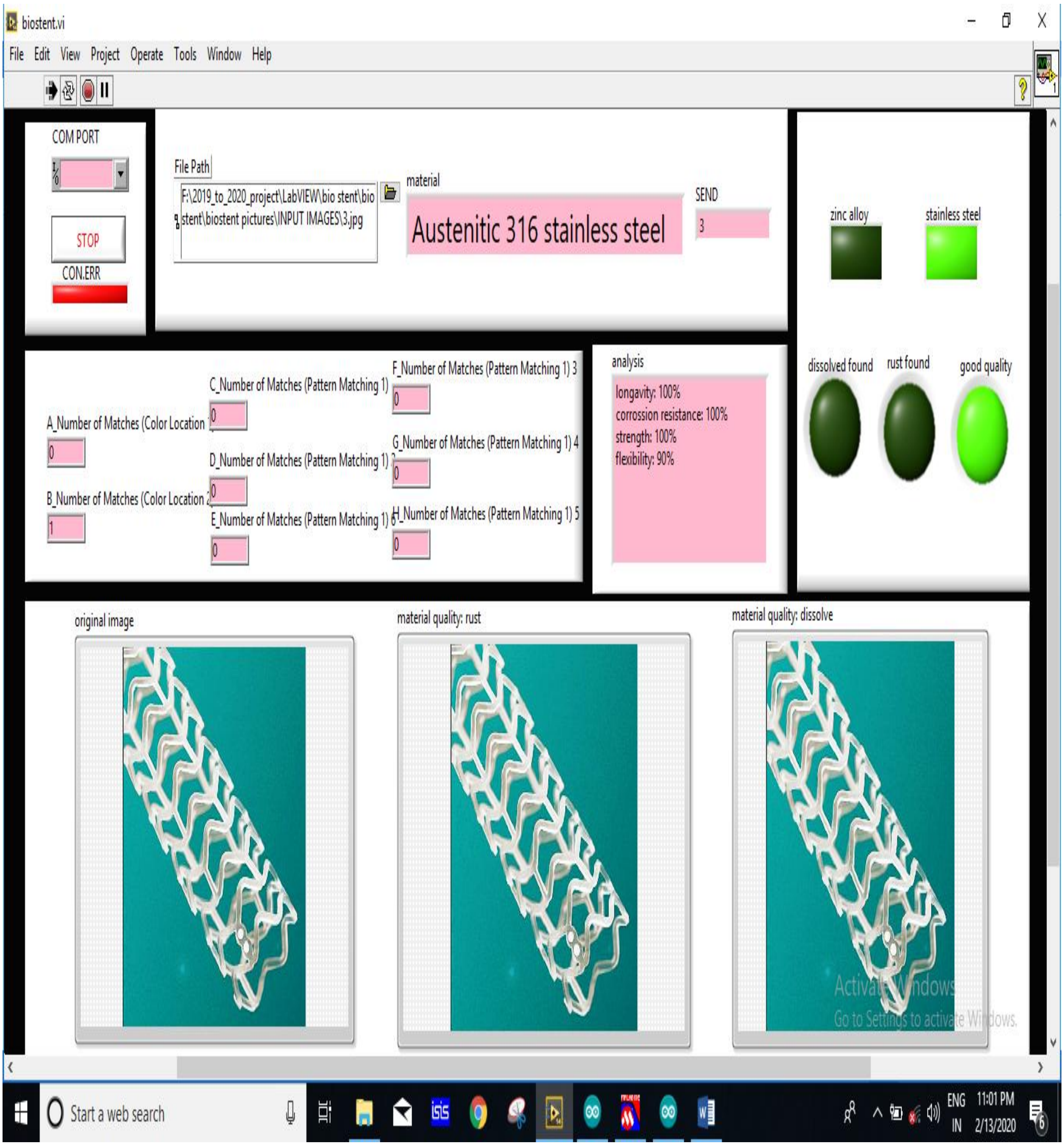

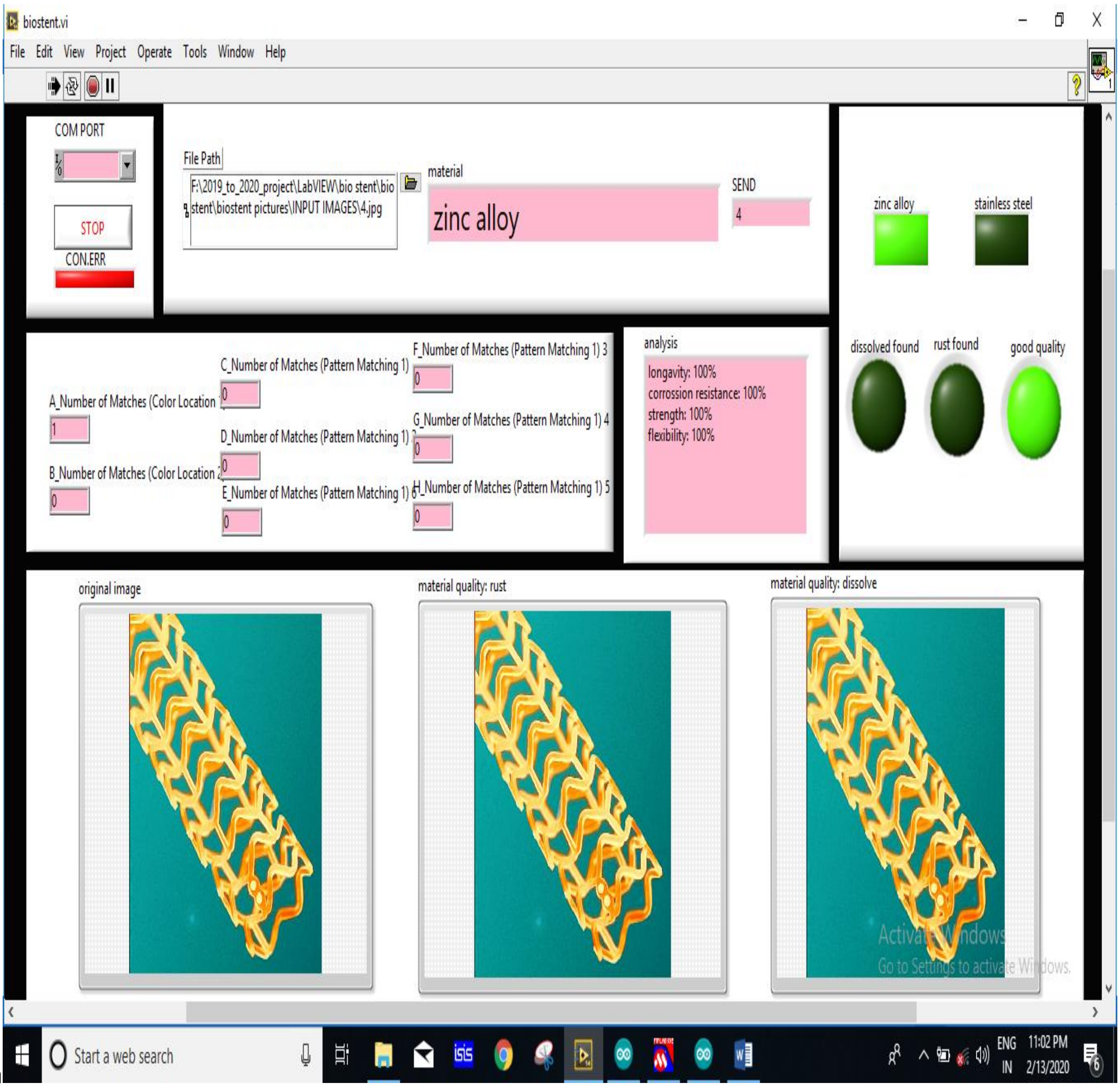

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