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# **Converting Writing Tools to Function as a Digital Pen through Motion Detection Without the Need of Any Special Surface**

## **Chapter 1: INTRODUCTION**

### **1.1 Background of the Study**

As the worldwide pandemic struck various countries, technology has built bridges between the people and in continuing life in this advent of the new normal. Several companies offered an advancement in their existing products with a goal to meet the needs or improve the experience of the users in various institutions. Digital pen is one of the devices that has been upgraded into a promising technological advancement. Its basic feature is to digitize, store, and transfer provided analog data with the convenience of using a pen-like tool.

However, despite the developments offered, it remained dependent on a surface that performs the majority of the essential data processing. With such, it compromised its capability to adapt and was not being maximized to its full potential.

Researchers Deselaers, Thomas, Keysers, Daniel, Hosang, Jan, Rowley, Henry A. (2015) introduced GyroPen, a method to reconstruct the motion path for pen-like interaction from standard built-in sensors in modern smartphones. Similarly, a journal published an article entitled “Trajectory-Based Air-Writing Recognition Using Deep Neural Network and Depth Sensor” led by researchers from Chungbuk National University and BRAC University. The said study used the concept of motion detection as well. An air-writing recognition system using three-dimensional (3D) trajectories collected by a depth camera that tracks the fingertip. (p.1)

On the other hand, Dong, Zhuxin Dong, Wejinya, Uchechukwu C., Li, Wen J. (2010), developed a Ubiquitous Digital Writing Instrument (UDWI) that captures and records human handwriting or drawing motions in real-time based on a Micro-electromechanical Systems (MEMS) Inertial Measurement Unit. In the system design, a high speed camera tracks and captures the written output.

Integrating the different concepts presented by the different studies, offers a more promising idea of digital pen: a wireless device attachable to any writing tool that gives it a digital pen feature. It is more convenient and more flexible because it requires no specific plane to process data. The written output will be reflected or shown in a computer screen.

Additionally, an included feature is to capture the screen available and save the data through a button click. Likewise, it provides a mouse-like feature that lets the user scroll the view on the screen.

## **1.2 Statement of the Problem**

Eliminating the surface dependency of digital pens by innovating a wireless device capable of providing any writing tools its essential features through motion detection with Inertial Measurement Unit (IMU) sensors that will record the trajectory of the writing tool and utilize bluetooth to transfer data.

## **1.3 Objectives**

### **General Objectives**

The purpose of this study is to reproduce the function of a digital pen to any writing tool through a different but feasible process. Also, with an additional enhancement feature such as screen scrolling and capturing.

### **Specific Objectives:**

- Provide a calibration method for the user
- Provide an initiating and terminating trigger for the device
- Collect and process data from the IMU sensor to be able to determine the accuracy of the output by comparing the actual writing to the digitalize strokes
- Transfer the desired data through bluetooth with minimal interval by measuring time delay from the moment the input starts and the output displays
- Scroll through and capture screen with negligible delay between the trigger and response

## **1.4 Significance of the Study**

This study will greatly benefit both educators and learners of learning institutions. For an online class, students and teachers can enjoy a setup more similar to the pre-pandemic setup. A teacher can write using a pen(marker) on a paper(whiteboard) in his home based work area, and the students who cannot attend the class real time may still have the copy of the lecture.

The device can also be helpful to some artists. Instead of having to draw manually and try to digitalize, both can be done simultaneously, saving effort and time.

It is beneficial to any individual or professional who prefers a digital copy of their works or notes. Also, it saves resources and materials.

Most importantly, it costs less than the commercially available digital pens. With its affordability and adaptability, it expands its market reach.

## **1.5 Scope and Delimitations**

The study mainly focuses on the most important and essential features of the digital pen. Hence, the aim is to replicate only the geometrical feature of the input as precisely as possible. Since it will be mainly relying on positions and trajectories, smallest details will not be visible. In addition, colors and shadings are not included in the desired output.

On the other hand, different users have different manners of handling writing tools. There may be certain writing approaches that will provide erroneous data or even unprocessable data. With such, there will be a more desired way of holding the writing tool the user must do. Also, the device is advisable to be attached on the tip of writing tools, provided that it will have sufficient space. Thus, bare hands, fingers or any body parts are not covered. as well as air writing.

There will be a minimal delay for the device to process and create the best possible imitation of the captured data. Likewise, since it relies on bluetooth to communicate the data, distance from the computer and the device will be within a certain bound.