CHAPTER 3: Design Considerations

The purpose of this study is to design a device capable of giving any writing tool a digital pen feature such as digitally capturing a handwritten output. This device does not require any surface to process the data as compared to commercially available digital pens. Instead, IMU sensors such as gyroscope, accelerometer, and magnetometer will be used in determining the approximate coordinates of the position of the tip of the writing tool. This design will integrate both hardware and software solutions.

3.1 Statement of the Design Problem

In order to construct an attachable device strategically integrating various hardware components which includes: microcontroller, sensors, power supply, and other miscellaneous parts for function and indicator purpose. The platform handling these components must be stable for accurate data to be achieved. Likewise, it will be designed to be non-invasive, not compromising and affecting the comfort of the user. This will include considering the overall physical size of the device to be as compact as possible.

3.2 Function Requirements

3.2.1 **********

The device shall function in three distinct stages:

a. Data Gathering
   a.1 Instruction Data
   a.2 Sensor Raw Data
b. Data Transfer
   b.1 Storage #stored data?
   b.2 Transmission #direct data?
d. Data Processing

Data Gathering

There will be two kinds of data to be gathered and processed.

Instruction Data

This data determines the specific operation the device will perform. This instruction will come from button triggers. Also, this dictates the start or termination of a function.

Sensor Raw Data
This refers to the numerical values to be given by the sensors directly to the microcontroller. This data will be the main component for the reconstruction of the handwriting

Data Transfer

The microcontroller plays an important role in this stage. It serves as the bridge between the sensors and the processing unit.

Transmission
The data gathered will be transmitted wirelessly via bluetooth. There will be light indicators indicating the status of connectivity. Additionally, wire transfer can also be an option for the user.

Storage
In instances where immediate transfer is unavailable, data will be stored first in an SD card until a processing unit is available.

Data Processing

In this stage, the available data will be interpreted accordingly. For the processing of sensor data, mathematical and statistical methods will be programmed using the Python language. This part requires a processing unit in order to achieve the desired outputs. The final data processed will be an image file.

3.2.2 Operation Modes

One of the instruction data to be set by the user is the mode to be used. It is the first data to be gathered every time the device is turned on.

REAL TIME OUTPUT DISPLAY (RTOD)
Once the sensors throw data to the microcontroller, the processing unit will immediately display the reconstruction of the handwriting.

STORE DATA, DISPLAY LATER (SDDL)
Upon receiving data from the sensors, the microcontroller will store the available data. In this mode, an initialization will be introduced.

3.3 Design Requirements

This part will focus mainly on the physical components of the device. They will be properly intact in a common surface with two adjustable clamp-shaped arms that will serve as the attachment to the writing tool.

3.3.1 Hardware Components

Microcontroller
The **TZT WEMOS ESP32** will be used because of its bluetooth connectivity feature. Likewise, its size is appropriate for the design consideration. It also has a built-in battery holder.

Sensor
The IMU sensor with 9 Degrees of Freedom (DOF) **MPU920** will be used. It is a 9 axis sensor consisting of 3 axis accelerometer, 3 axis gyroscope, and 3 axis magnetometer. It will provide the yaw angle, pitch angle, and roll angle. It is capable of both I2C and SPI data transfer. For this design, the I2C communication protocol will be used.

Power Supply
The preferred microcontroller is set to function in a **18650 rechargeable lithium-ion battery**. For the sensor, the microcontroller will provide the power from its 3.3V pin

Storage
A **Micro SD Card Module** will be connected to the microcontroller through the Serial Peripheral Interface (SPI). The maximum storage capacity will depend on the SD Card to be used.

Buttons
To minimize the space the buttons will occupy, Sealed Tactile Switch will be used. This buttons will serve as the interaction of the user to the device to set or trigger certain operations.

LEDs
Bicolor Red Green size 0603 SMD LED is to be used as an indicator for the power and connectivity status.

3.3.2 Mechanical Requirements

To be able to strategically place the hardware components, the platform will be 3D - printed provided the following dimensions:

* FIGURE HERE HEHE*

Since writing tools vary in diameter, the clamp will be adjustable via screw. The adjustable diameter size will range from _____ to _____.

CHAPTER 4: METHODOLOGY

1. Overall Hardware Block Diagram
   Writing Tool
   MCU senso- button,LED, storage module
   Processing Unit

   1.1 MCU connections - pin allotment
   1.2 MCU - bluetooth, wired - Processing Unit

2. Overall Software Block Diagram

3. Flowchart
   3.1 For Sensors
   3.2 For Buttons
   3.3 For LED
   3.4 For Storage
   3.5 For Data Transfer

4. Technique/Method/Computation to be used to reconstruction of writing

5. Evaluation Chenes
   5.1 Data Collection and How (Time to process, Pagkahawig, Connection distance, Storage, gano kadami)
   5.2 Research Settings
   5.3 Site and Participant

6. Definition of Terms