Simultaneous Morse Code Telegraphy using Arduino UNOs

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INTRODUCTION

- Morse code is a known system for transmitting information through standardized sequences of short and long elements that encode the characters of a message. Telegraphy is the study of long-distance transmission of textual messages using non-physical channels and explores the Morse code communication system.

- A modern telecommunication system must overcome three obstacles to achieve effectiveness: simultaneity, verification of delivery, and latency.

- This project introduces a modern-day telegraphy apparatus using Arduino UNOs and an original program that allows simultaneous communication in a one-way radio transmission.

- Additional features were added to improve the user experience, such as: integrated and user-friendly LCD display, instantaneous code-to-letter conversion, verification of delivery, customizable Morse code characters, backspace and erase function.

Figure 1: International Morse Code Reference.

DEVICE

Arduino UNO: A micro-controller that provides the processing power needed to manipulate and covert the user input (the Morse Code input) to the desired output (radio waves). It is able to convert the Morse Code into alphanumerical characters and implement features specified by the source code our team designed, such as: verification of delivery, backspace functionality and simultaneous communication.

HC-12 Wireless Serial Port Module: The HC-12 module has five pins: TX, RX, SET, GND, VCC. GND and VCC are used to provide power to the HC-12. TX is a transmission pin, it takes the data from the Arduino UNO in the form of pulsating digital electric waves and converts it into radio waves. The radio signals received by the HC-12 are converted to pulsating digital electric waves, which are then sent to the Arduino UNO through the RX pin, also known as receiving pin.

LCD Display Module: The display is for debugging purposes and to provide a visual interpretation of the Morse Code transmissions. The display analyzes the transmission status: if the device is running properly the display will feature an "S:" row, documenting the 'SENT' message; the same is true for the receiving line. An "X:" is displayed if the message transmission failed.
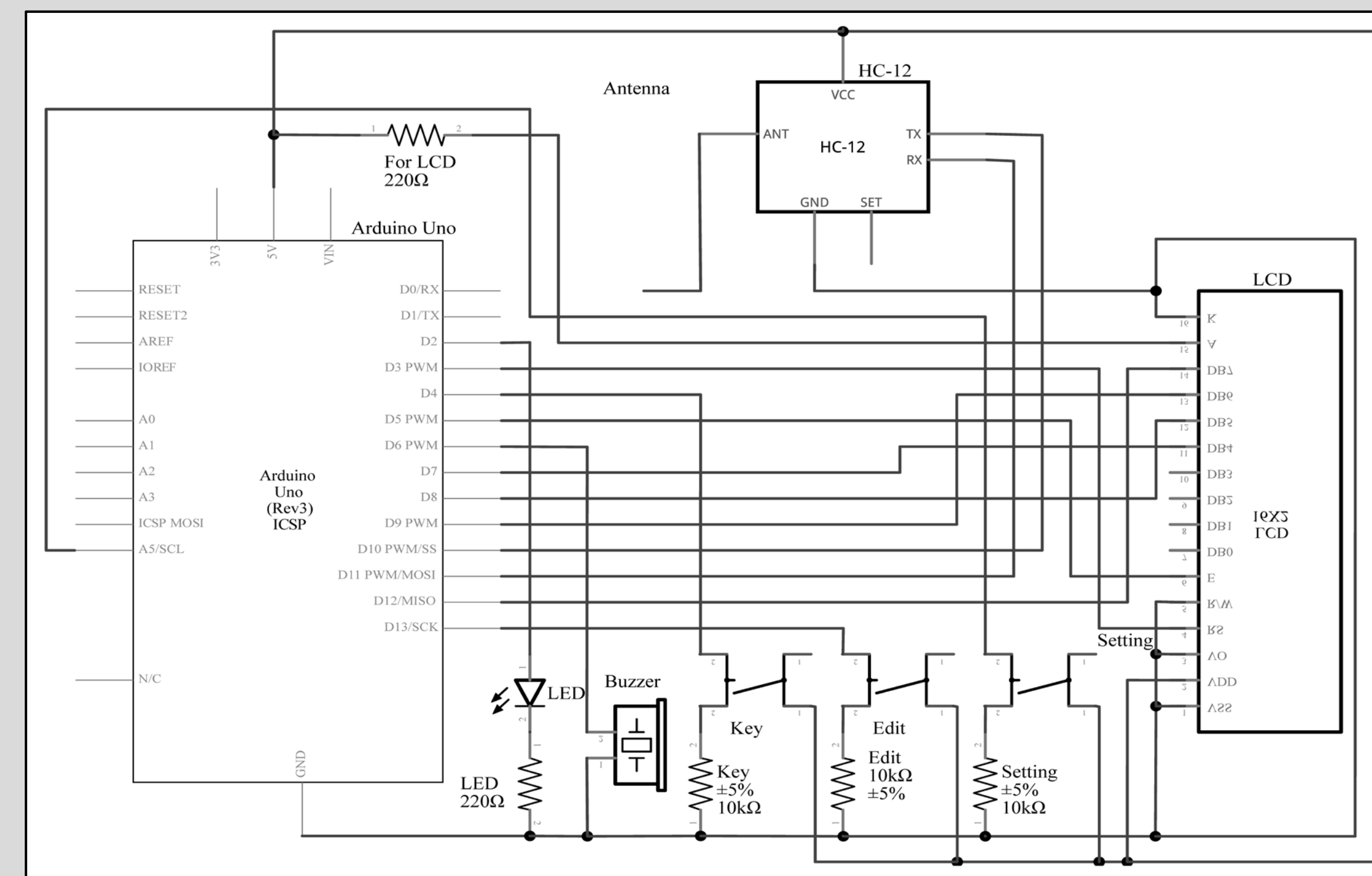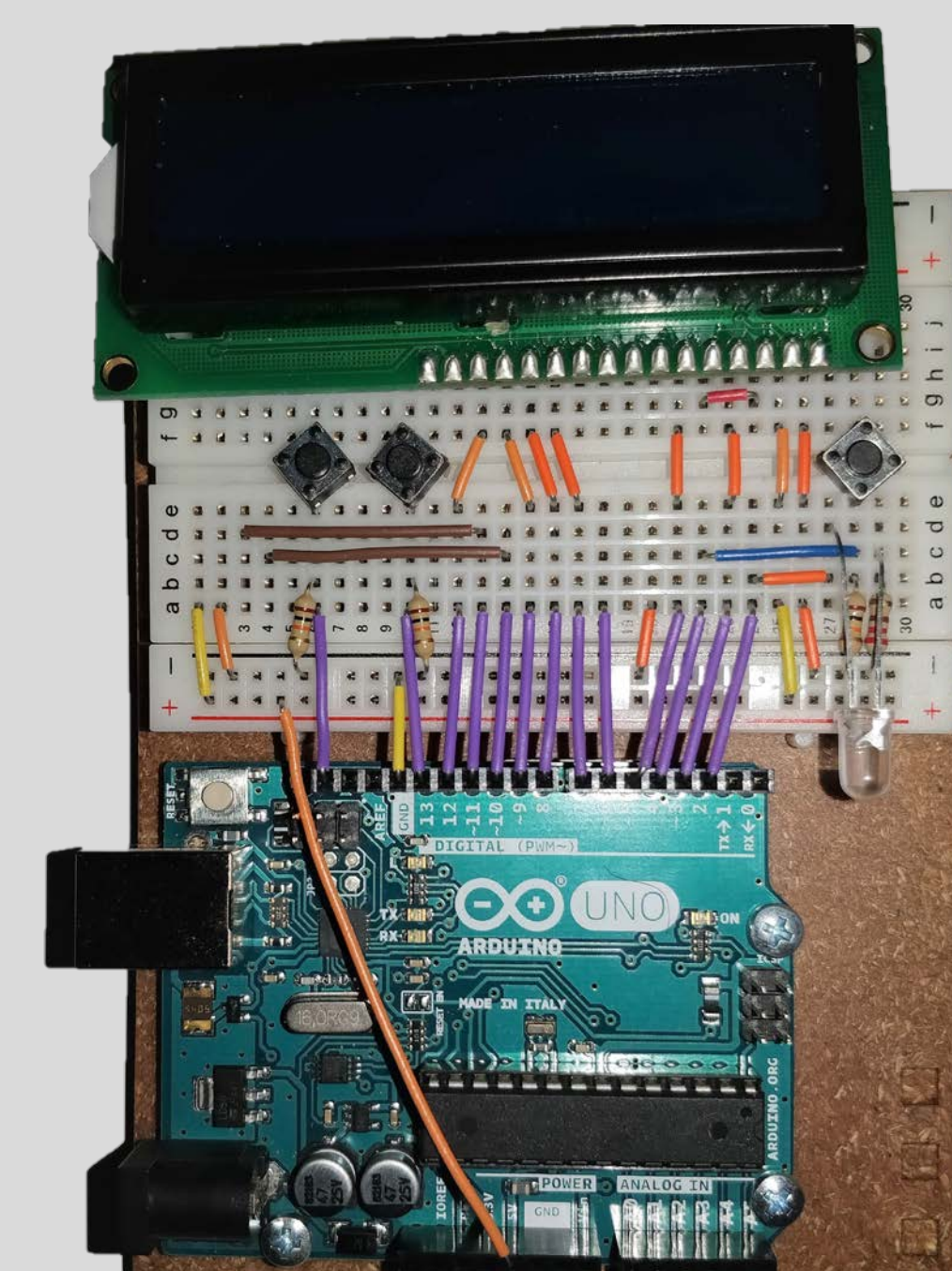
SCHEMATICS

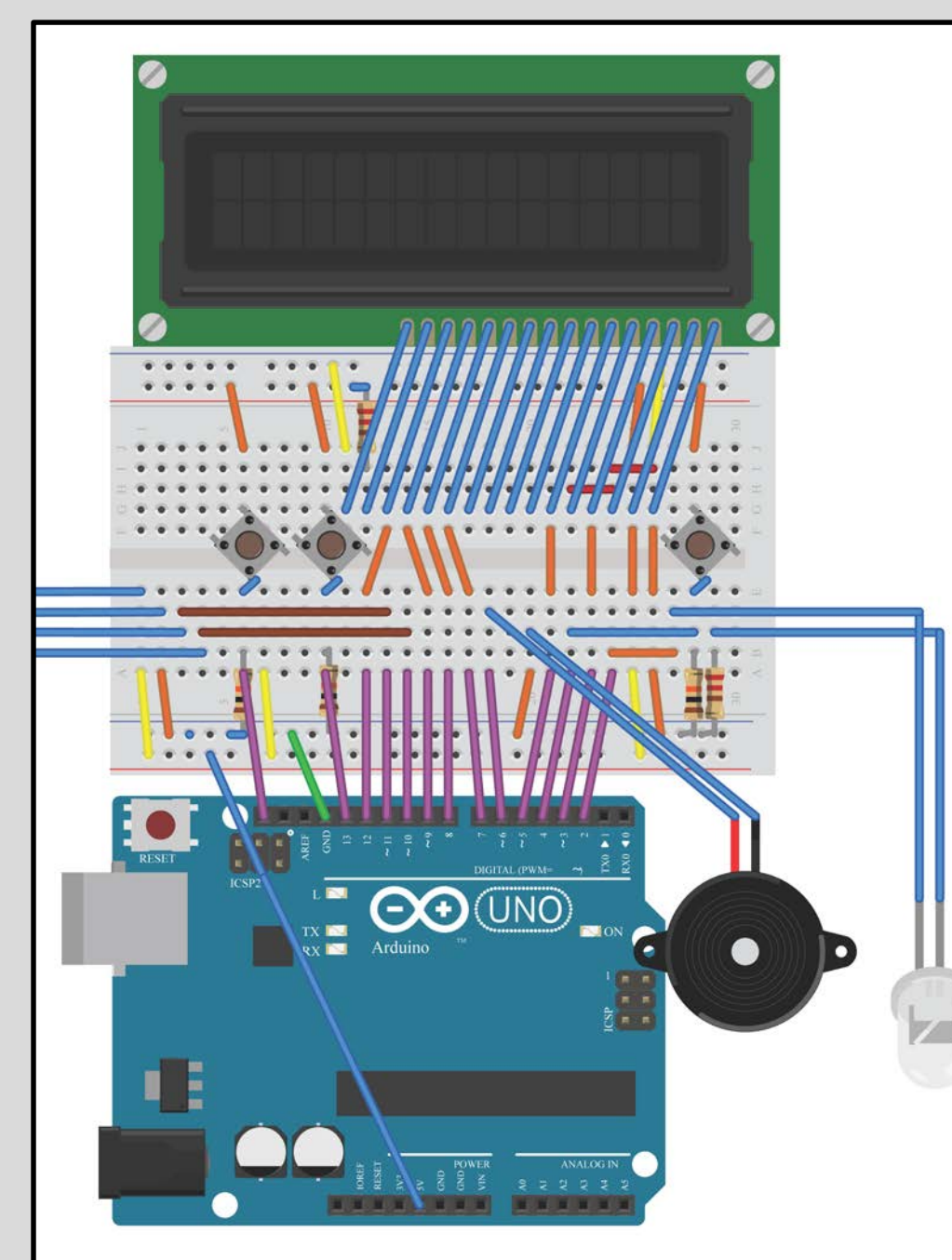Figure 2: Schematics of the Device

Picture 1: Assembled Device


Figure 3: 2D Design of the Device

DATA

	Location Setting:	Maximum Range without any dropout:	Maximum Range:
I	Open city-like location with surrounding buildings, no obstacles, in a straight line	92 m	96 m
II	In a closed building, no obstacles in between, in a straight line	99 m	104 m
III	In a closed building crowded with people, in a straight line	78 m	82 m
IV	In a closed building, a wall in between, with a 90 degrees angle between the antennas	40 m	43 m
V	In a closed building, 2 walls in between, with two 90 degrees angles between the antennas	26 m	35 m
VI	In a closed building, 1 wall in between, with two 90 degrees angles between the antennas	37 m	37 m
VII	Inside a closed building, semi-open space	1 floor	2 floors
VIII	Open football field, in a straight line, few buildings surrounding the areas	66 m	76 m
Note: Time delay for each location with in maximum Range was 547 milliseconds			

RESULTS
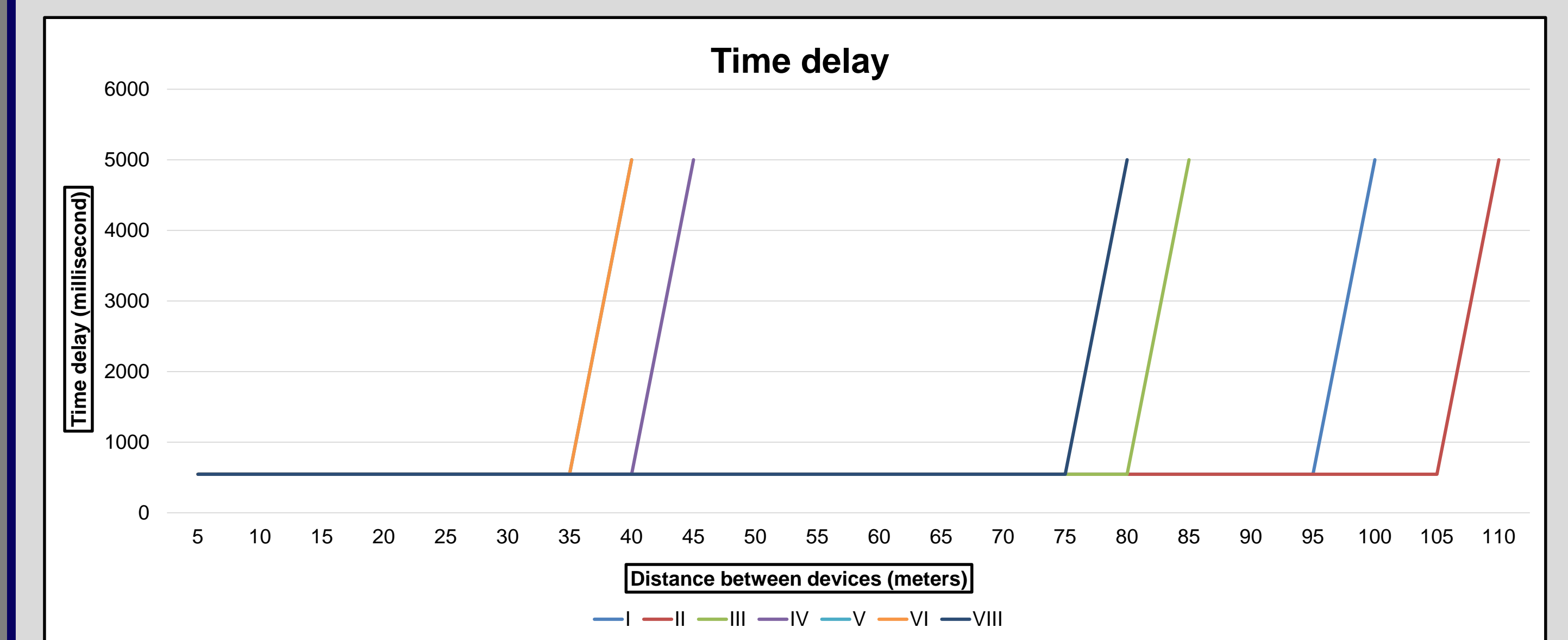
Graph 1: 2D Representation of Time Delay
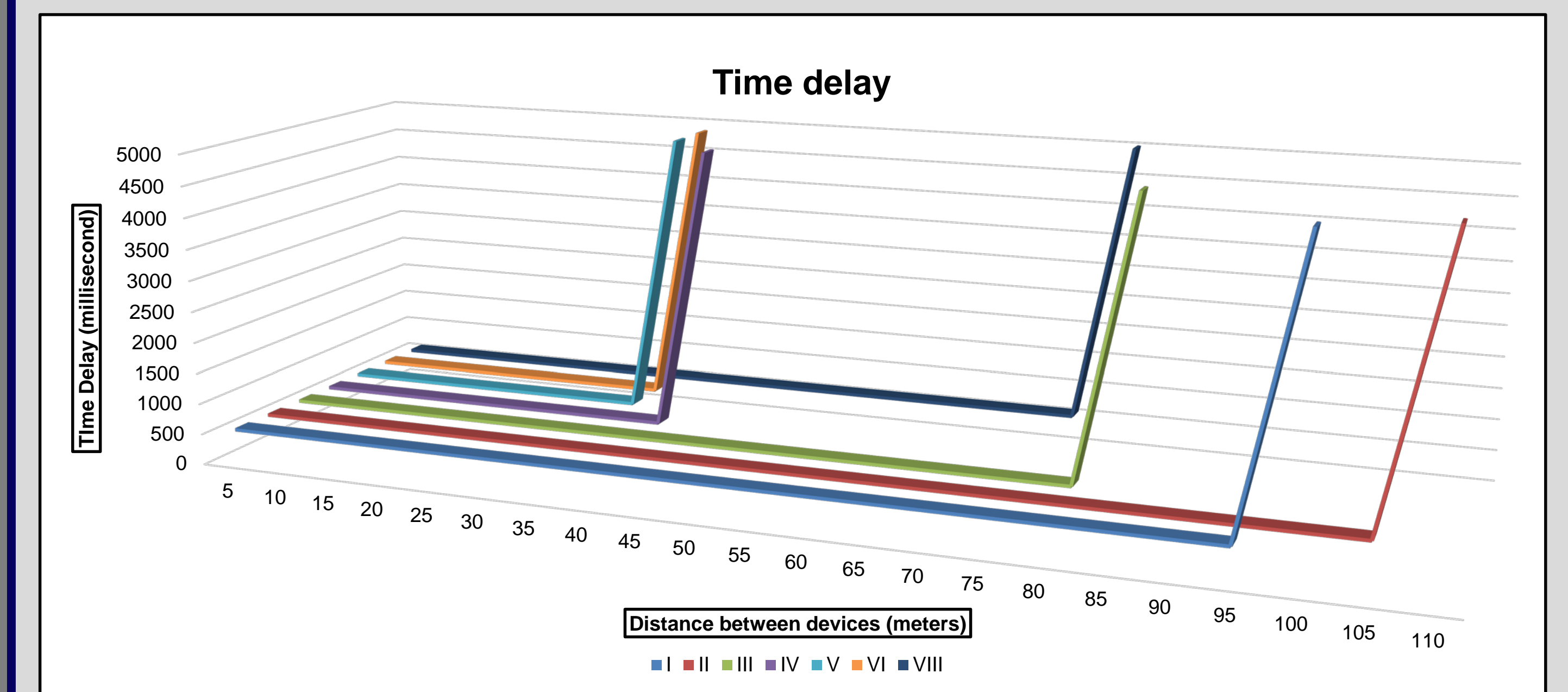
Graph 2: 3D Representation of Time Delay

CONCLUSIONS

- The creation of these functioning devices demonstrates that a simultaneous wireless telegraphic communication system is possible even when the antennae (HC-12) used can only transmit or receive at a given time.

- This is possible by making use of the Half Duplex Mode: adding a function to the source code that rapidly switches between the two states (transmitting and receiving).

- This project also challenged us with the creation of a communication system that does not rely on the internet, on which many modern devices rely.

- Even though the devices work properly and reliably, this project is still a prototype and may contain unforeseen bugs in the code; there could also be improvements to the user experience and integrity of the device.

References

†: The authors shared the work and credit equally.
Figure 1: https://www.chegg.com/homework-help/questions-and-answers/write-program-python-automatically- converts-english-text-morse-code-program-respond-approp-q24075856

Acknowledgments