Development of a Cubic Diode Array the Dosimetric Quality Control of a Linear Accelerator

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ABSTRACT

The new technological advances in radiotherapy techniques [1] have brought with them the importance of 3D dosimetry [2], due to this and to carry out initial experimental tests an electronic detector with a cubic diode arrangement based on a concept matrix [3] [4] for dosimetry quality control of a linear accelerator.

The electronic detector consists of 125 BPW34 photodiodes, distributed in an area of 20 x 20 x 20 cm3 covered with material equivalent to water, for data processing a data acquisition system with STM32 microcontroller was developed and for communication between micro controllers the RS485 protocol was used. The experimental tests were carried out with a Varian 2100 C / D accelerator with photon energy of 6MV varying the accelerator input parameters in order to obtain the linearity response, field factor, profiles and percentage of dose in depth PDD.

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Figure 1. Label in 2pt Arial

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INTRODUCTION

Dosimetry quality control is typically performed on a water phantom with an ionization chamber, or an array of diodes which allow immediate measurement but corresponding to a two-dimensional array. This is how the development of the low-cost electronic detector arises to obtain a three-dimensional measurement, and thus facilitate the process of sampling.

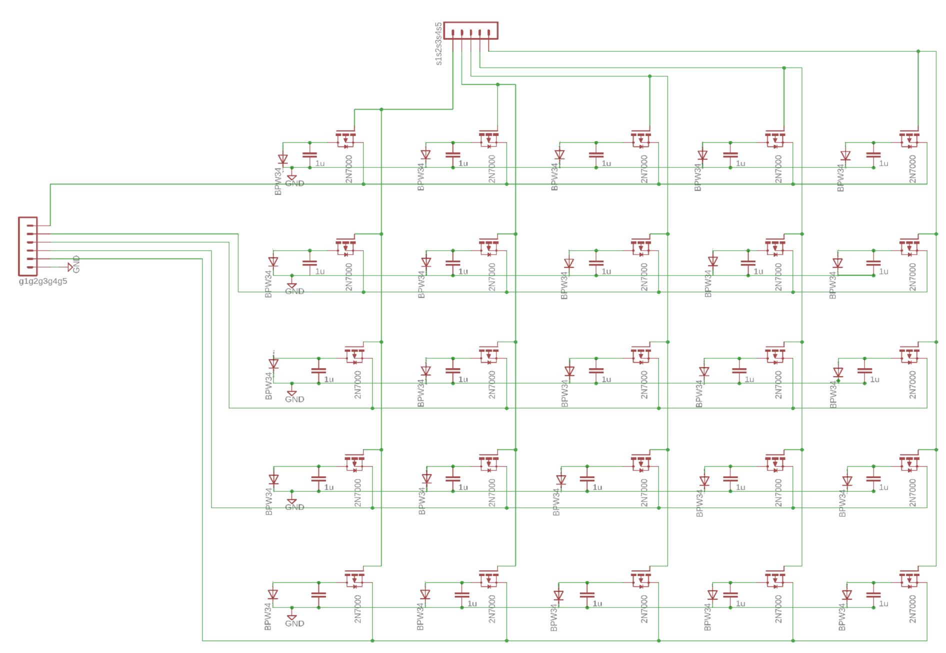

Figure 2. AM. planar with 25 pixels..

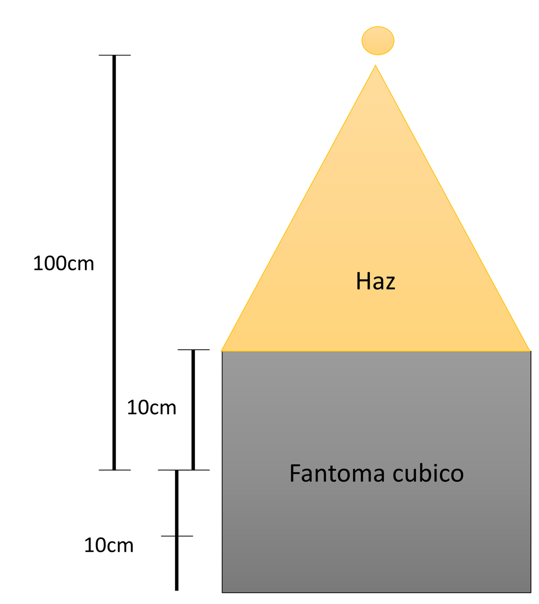

Figure 3 . data collection scheme.

METHODS AND MATERIALS

The electronic detector or cubic phantom developed under active matrix (AM) technology processes the received x-ray data, pixel by pixel inside a cubic detector. One pixel of the MA consists of a BPW34S photodiode as a detector, a 1 uf storage capacitor to maintain the charge and a 2N7000 mosfet to activate and deactivate the charge flow (Figure 4) 5 electronic cards have been developed with a 25-pixel planar matrix distributed in 5 rows and 5 columns with a 1 cm separation between detectors(Figure 2) in signal conditioning, electronic boards have been developed with a signal coupling system (Figure 4). a data acquisition system has been developed for data processing (Figure 5) with STM32 microcontroller (small, powerful and easily acquired) and for communication between microcontrollers the RS485 protocol has been used (it allows a series connection of multiple points, simple, robust and long transmission distance) (Figure6).

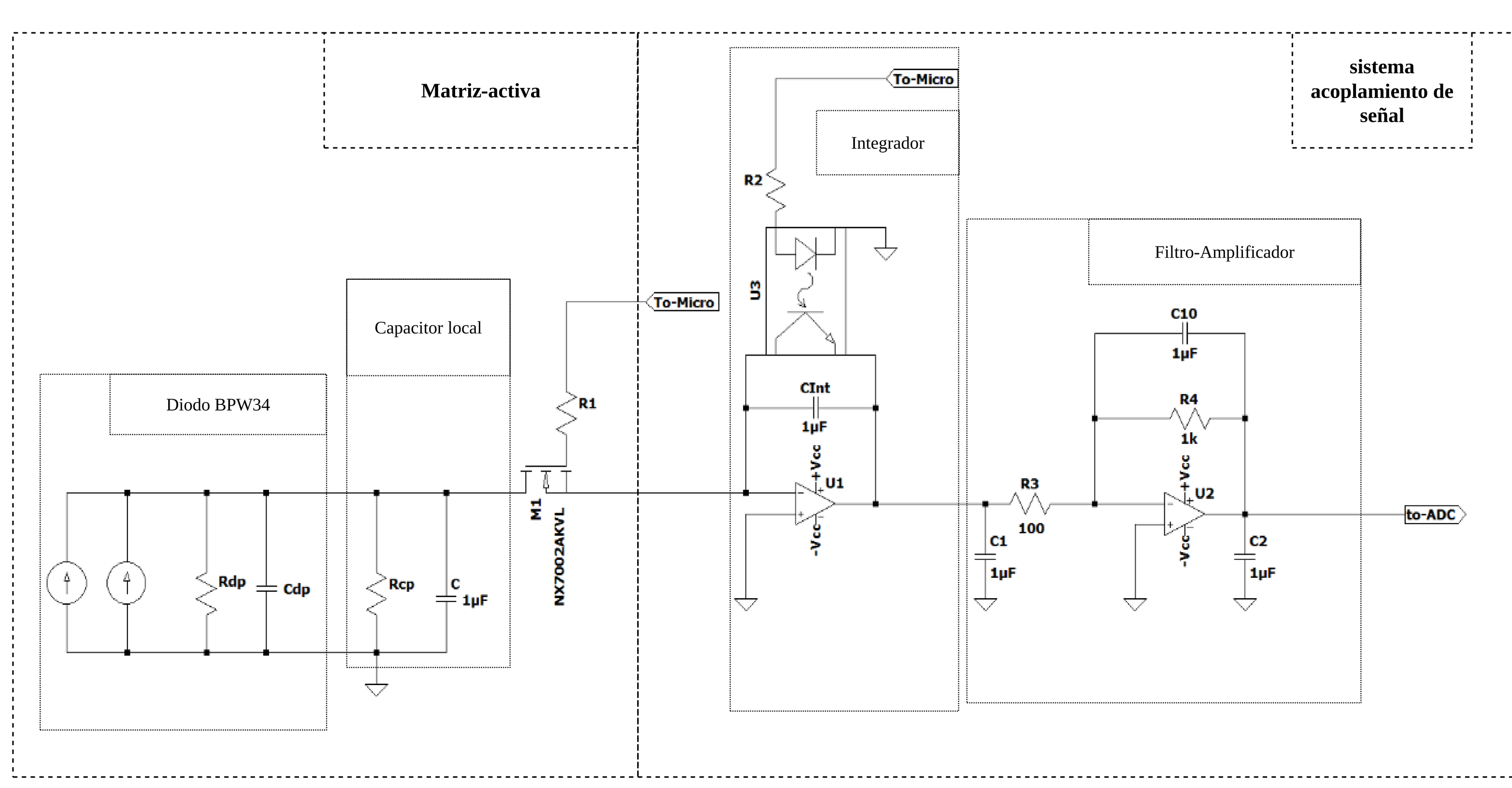

Figure 4. Single pixel electronic circuit, integrating circuit and signal amplification and filter circuit.

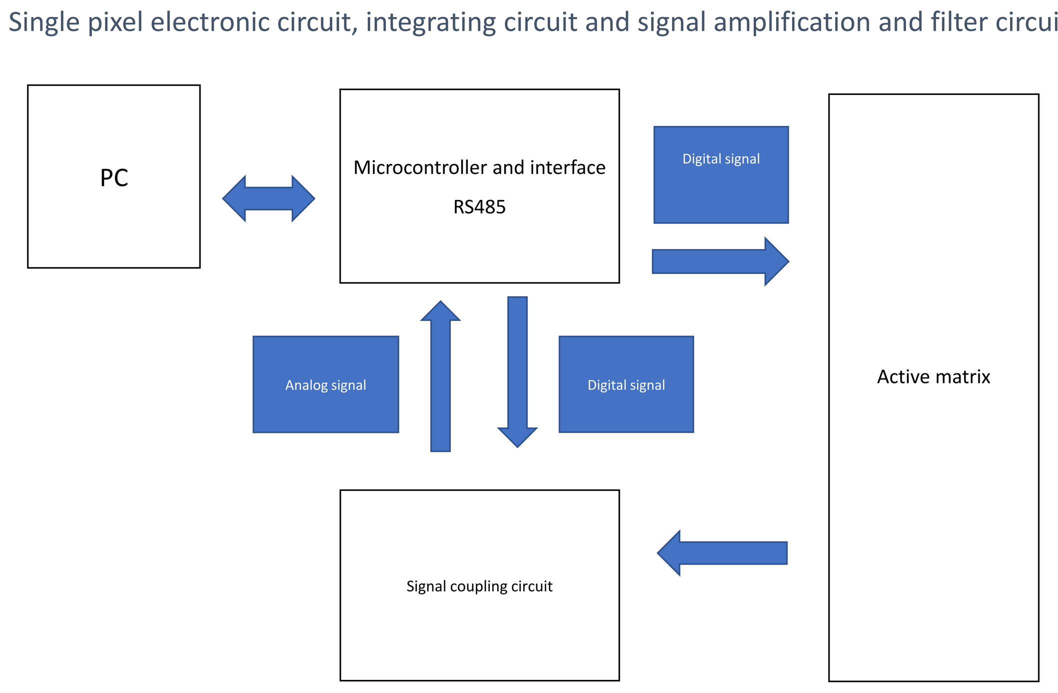

Figure 5. Block Diagram for the Cubic Phantom Data Acquisition System.

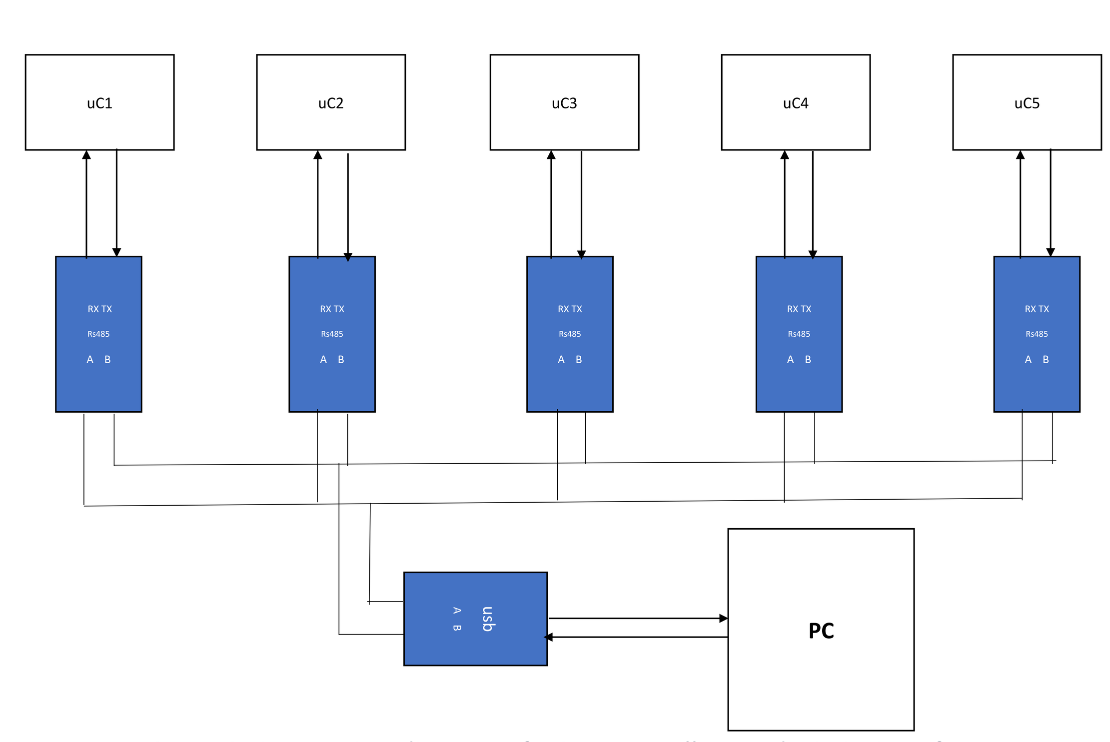

Figure 6. Connection diagram of microcontrollers and RS485 interface.

RESULTS

The results of the electronic detector compared with the ideal data obtained from a commercial computerized planner for the linearity response, field factor (Figure 8) profiles, and percentage of dose in depth PDD (Figure 7) provided results with a maximum percentage difference of 5.97% and minimum of 0.99%. Demonstrating that the built detector allows the dosimetry of a 6MV linear accelerator.

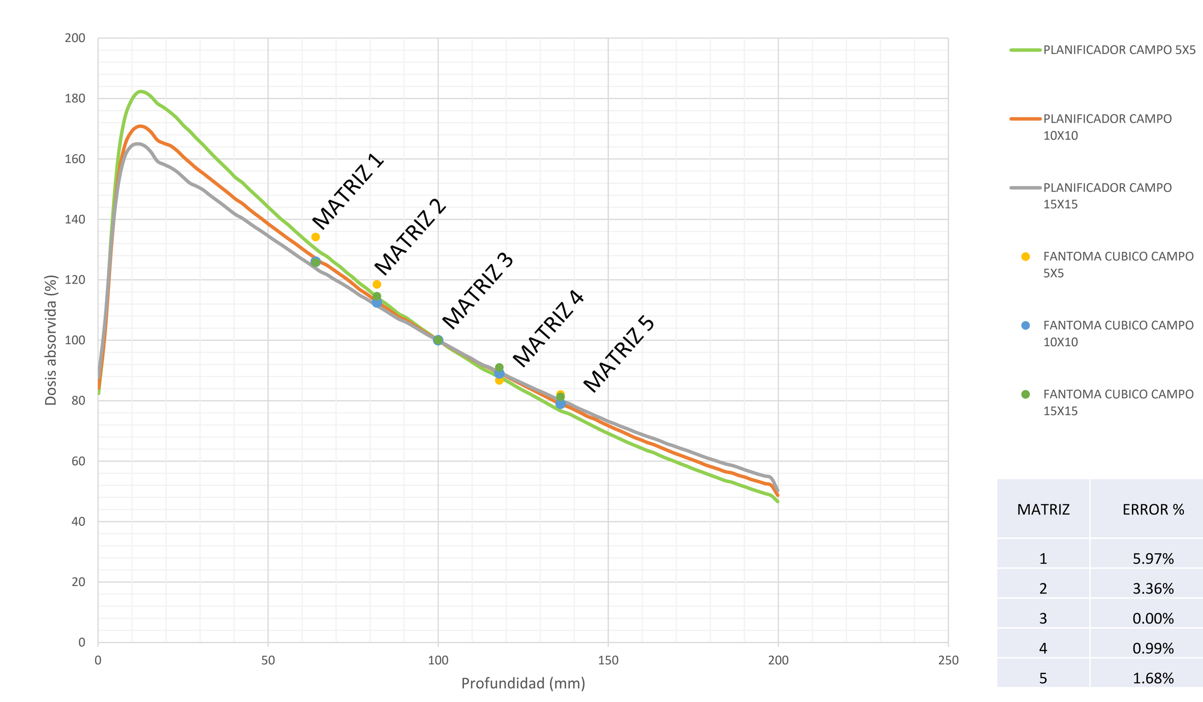

Figure 7. PDD normalized to the central detector of the cubic phantom.

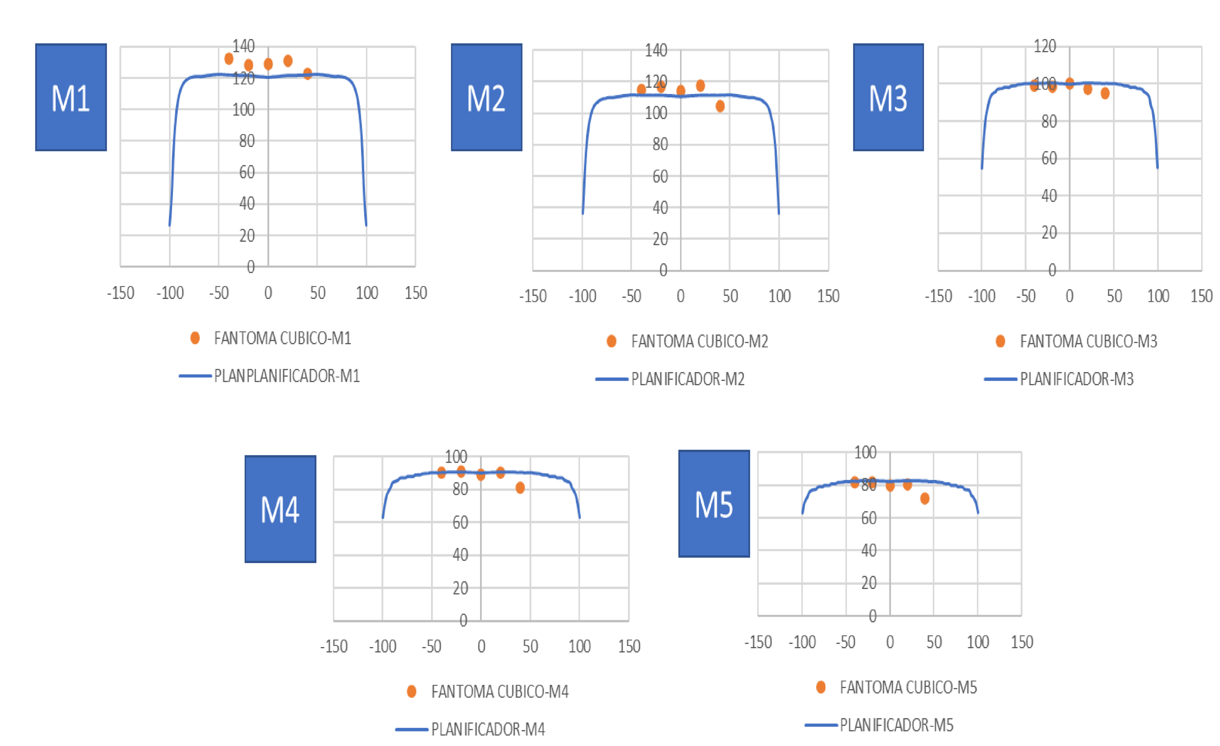

Figure 8. Field profile 20 x 20 .

CONCLUSIONS

The electronic detector with a cubic diode array based on an active matrix concept for the dosimetry quality control of a linear accelerator has been validated by experimental tests demonstrating the feasibility of constructing other detectors for further studies and improving the percentage difference. Showing that the built detector allows the dosimetry of a 6MV linear accelerator.

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