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Tesis: **"RGB AND MULTISPECTRAL IMAGE ANALYSIS BASED ON DEEP LEARNING FOR REAL-TIME DETECTION AND CONTROL OF WEEDS IN CORNFIELDS"**

Resumen:

Weeds drastically reduce the harvest volume of maize and the quality of forage if not controlled in time. Spraying herbicides is the most commonly used method for controlling weeds worldwide; however, it has led to environmental pollution.

Intelligent mechatronic systems for mechanically removing weeds or selectively spraying herbicides are being considered as alternatives to address the struggles associated with herbicide usage. Nevertheless, detecting undesired plants under authentic cornfields poses a significant challenge. Therefore, in this thesis, a visión system based on deep learning (DL) was proposed and developed for real-time detection and control of weeds in these complex scenarios. To develop the visión system, a large dataset of RGB and multispectral images was primarily created and annotated at the pixel level. Subsequently, both shallow and deep learning classification algorithms were explored. Additionally, end-to-end semantic segmentation convolutional neural networks (CNNs) were proposed for weed detection.

The combined use of segmentation and classification networks was found to be beneficial for detecting weeds in natural cornfields. Transformer architectures for semantic segmentation were also explored, yielding better results tan CNNs. Our optimized transformer achieved a Dice similarity coefficient (DSC) >of 90.24% and a mean intersection over union (mIoU) of 82.91 %. Afterward, a mechatronic platform commanded by the vision system, named the Smart Weed Sprayer (SWS), was developed. The SWS was evaluated in an authentic cornfield experiment, achieving a 45.64% reduction in herbicide usage compared to a conventional weed sprayer (CWS). Moreover, similar effectiveness in weed control was observed between the SWS and CWS. Therefore, employing DL for weed