

An AI-Powered VVPAT Counter for Elections in India

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Agenda

1. *India* - The Largest Democracy and Election History
2. Problem Statement - Election Commission - VVPAT
3. Automated VVPAT Counter
4. Methodology, Results and Recommendations
5. Code & Reproducibility

India - The Largest Democracy and Elections

- The first General Elections were held in 1951-52.
- India's total electorate as on Jan 1, 2023 is estimated at 945 Million.
- Ballot Papers were used until 1990. Electronic Voting Machines replaced Ballot papers during 2004 Parliament elections.

Election Commission - VVPAT - Problem Statement

- Opposition Concerns around transparency and tampering since early 2000 's
- VVPAT - Voter Verified Paper Audit Trail introduced in 2019 during parliament elections
 - Improved Voter Confidence.
 - Counting - Validating every EVM and VVPAT pair is a practical challenge.



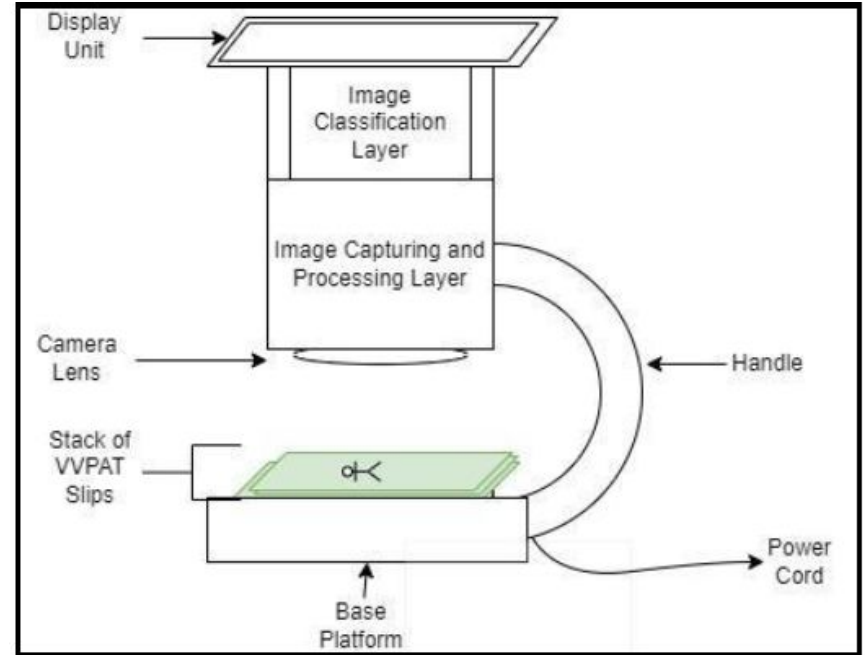
Election Commission - VVPAT - Problem Statement

- Key Challenges
 - Mismatch between the EVM and VVPAT still occurs however small the difference be.
 - As the number of EVM machines that are subjected to physical verification increases, the amount of time required to declare the results also increases.

In one of the affidavits that the ECI filed in the Supreme court, it cited logistical difficulties in verifying 50% VVPAT slips, which would delay the announcement of results by **6 days**. This would also require extensive training and capacity building of election officials on the field.

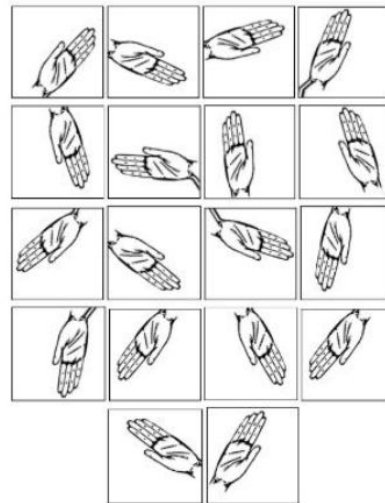
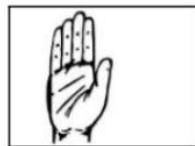
Automated VVPAT Counter

1. As per the 56D (4)(b) of the Conduct of Election Rules, 1961, if there is any discrepancy between the EVM count and VVPAT count the latter prevails, which nullifies the counts from the EVMs.
2. An AI Powered Counter to count VVPAT slips and assign labels to each slip - Reduced to a Multi-Class Supervised Learning Modelling Problem.
3. Focus here is the learning problem - Image on the right illustrates a proposed design of the prototype that can be greatly improved.



Methodology - Results - Recommendations

1. Dataset - Party Symbols of 49 National and State Registered Parties approved by the ECI. Labels are party names as registered in the ECI
2. Pre-trained Image Classification models MobileNetV2 and ResNet 50.
3. Customized Output Layer with 49 Neurons to associate with the party symbols. Transfer learning methodology saves time during the training phase.



Methodology - Results - Recommendations

1. Scalable for every constituency due to the dynamic nature of the contesting parties/candidates. Train a global model with all party symbols assigned by the ECI for an election.
2. 98% and 99% accuracy with MobileNetV2 and ResNet50 models respectively. (MobileNetV2 is **10x** smaller than ResNet50 in size)
3. 6 party symbols had recall of ≤ 0.80 . Human Intervention in the scenarios of prediction below a certain probability
4. TimeStamp on each VVPAT Slip.

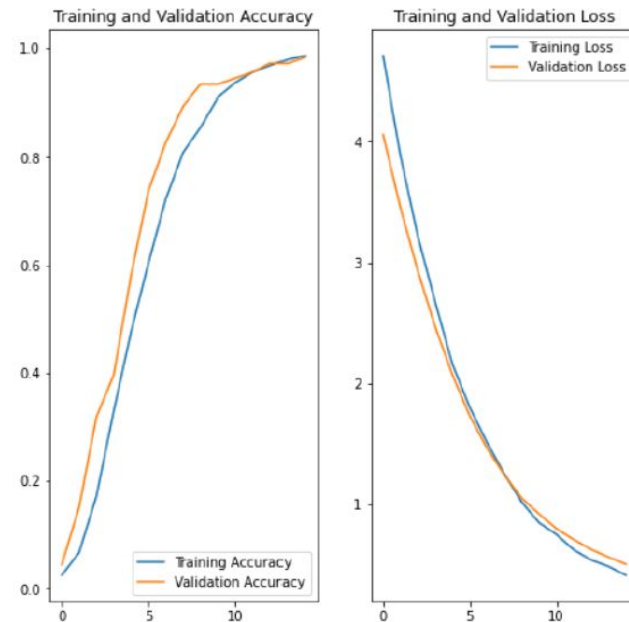


Figure 4: Accuracy and Loss plots for the training and validation sets by Epoch(x-axis) of ResNet50

Code & Reproducibility

Preprint version : <https://arxiv.org/abs/2212.11124>

Code : <https://github.com/Prasath2001/Party-Symbol-Classfier>

Dataset : <https://www.kaggle.com/datasets/prasathm2001/indian-party-symbol-dataset>

Web-app : <https://votecounter.streamlit.app/>



THANK YOU!
