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ME-CapsNet: A Multi-Enhanced Capsule Networks with Routing Mechanism

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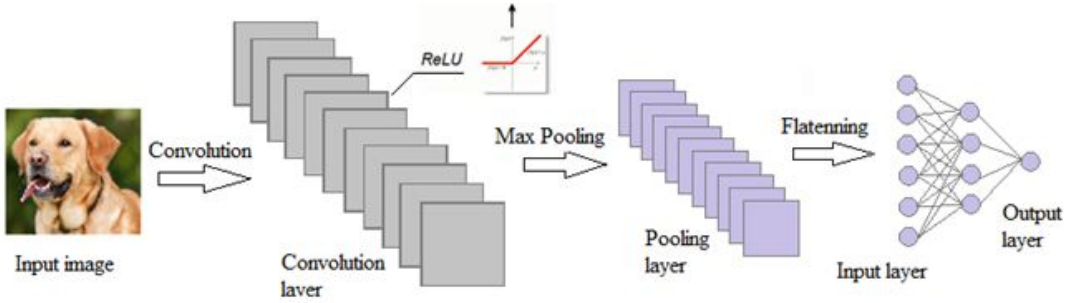
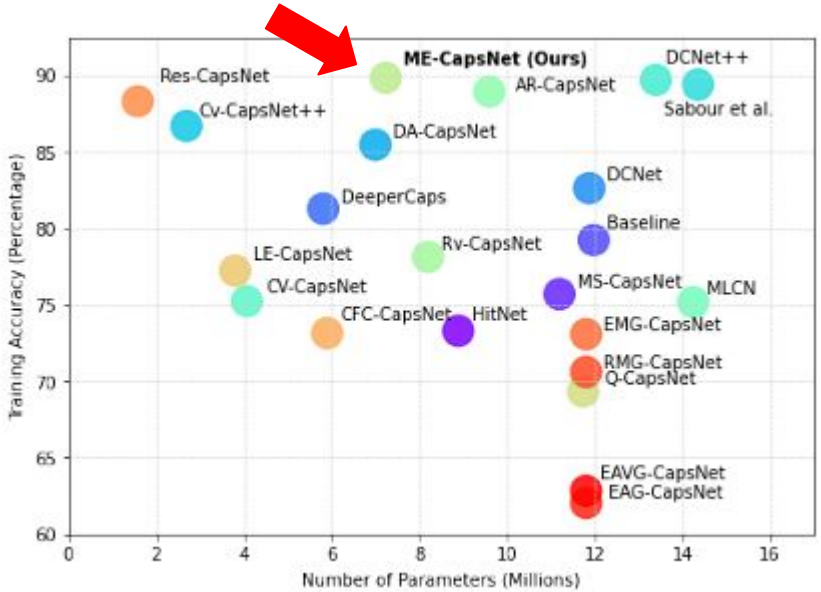
Introduction

- **CNN** - Efficient in Detecting Features
- **CNN Prob1:** Weak Spatial Relationship
- **CNN Prob2:** Poor Routing
- **Solution: Capsule Network**



Literature Review

- Scope of improvement
- 20+ research works
- Improvements:
  - Network
  - Routing



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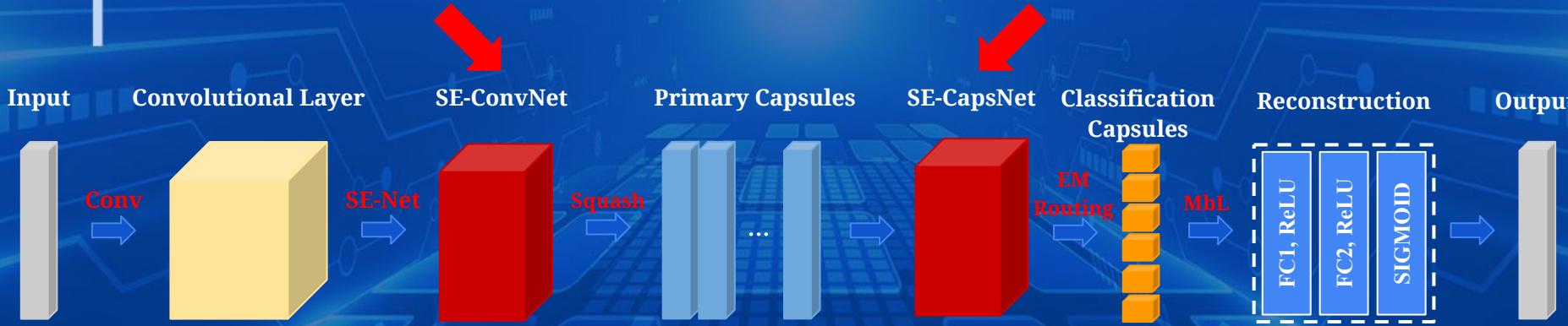
Architecture



Capsule Network

What is CapsNet?

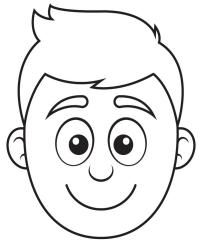
CNN - Features

CapsNet - Features and variants

Why CapsNet?

- ➢ Less training data
- ➢ Rotation invariant

“Final label is always viewpoint invariant”



0.90, 0°

0.90, 45°

ACCURACY ?

Capsule Network

How to improve Accuracy of Capsule Networks?

- Tweaking parameters

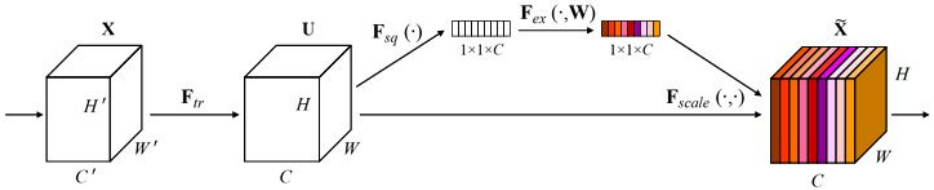
CAPSULE DIMENSION

Dimension	Accuracy
8	**89.84%**
12	89.12%
16	88.57%

NO. OF CAPSULES

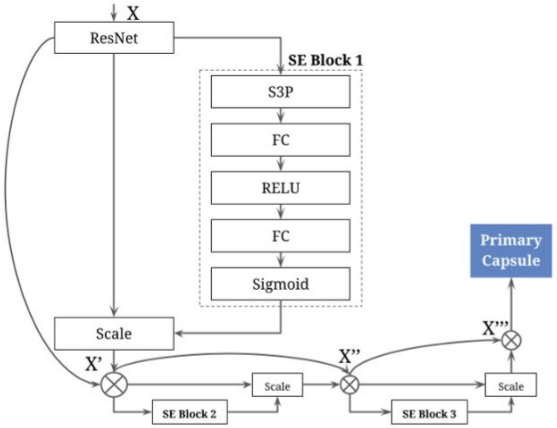
Number	Accuracy
5	88.79%
8	**89.84%**
10	86.44%

- Adding depth to the network



Squeeze-Excitation [SE] Network

What is SE-Net?



Tweaking SE-Net

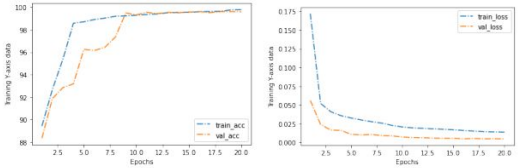
➢ Pooling with Stochastic Spatial Sampling

$$z_{max} = max_{i,j} \cdot u_c(i,j) \qquad z_{s3p} = \mathcal{D}_g^s \cdot (z_{max})$$

COMPARISON WITH SE PARAMETERS.

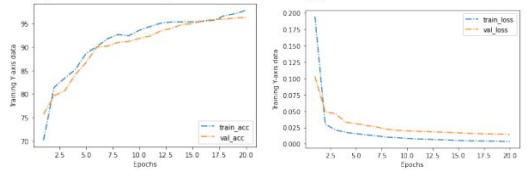
	top-1%	top -5%
Squeeze - Max	22.57	6.09
Squeeze - Avg	22.28	6.03
Squeeze - S3P (Ours)	**21.78**	**5.83**
Excitation - Sigmoid	22.28	6.03
Excitation - ReLU	23.47	6.98
Excitation - LeakyReLU	23.22	6.91
Excitation - TanH	23.00	6.38

Experimentation



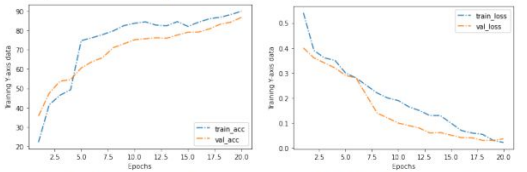
(a) MNIST Training Results

(b) MNIST Loss Results



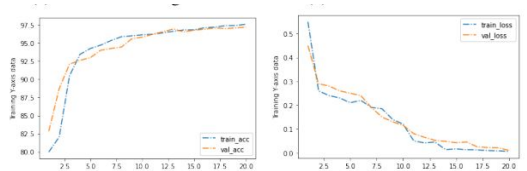
(c) FMNIST Training Results

(d) FMNIST Loss Results



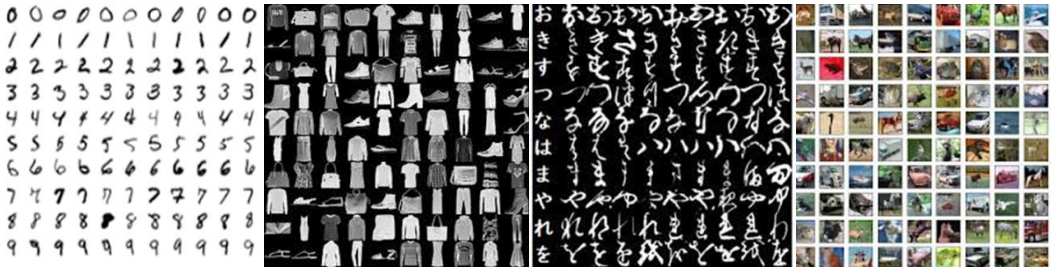
(e) CIFAR10 Training Results

(f) CIFAR10 Loss Results



(g) KMNIST Training Results

(h) KMNIST Loss Results

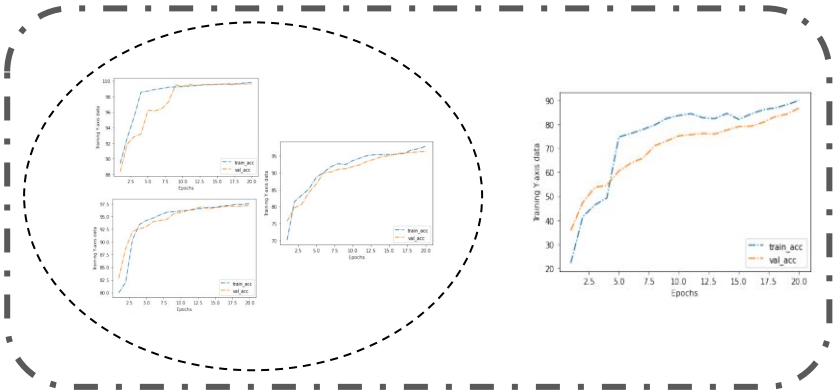


COMPARISON WITH VARIOUS PROPOSED NETWORK.

	Accuracy	# of Params	Recon.
HitNet [11]	73.30%	8.89M	Yes
MS-CapsNet [29]	75.70%	11.20M	Yes
CapsNet Baseline	79.24%	11.98M	No
DeeperCaps [30]	81.29%	5.81M	Yes
DCNet [31]	82.63%	11.88M	Yes
DA-CapsNet [12]	85.47%	7M	Yes
Cv-CapsNet++ [32]	86.70%	2.69M	No
AR-CapsNet [33]	88.94%	9.60M	Yes
Sabour et. al. [5]	89.40%	14.36M	Yes
DCNet++ [31]	89.71%	13.4M	Yes
ME-CapsNet (Ours)	**89.84%**	7.24M	**Yes**

Conclusion and Future Work

- *A novel end-to-end architecture*
- *S3P with Squeeze-Excitation layers*
- *State-of-the-art results in terms of performance and computation*



- Complex datasets
- Pooling layers

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THANK YOU