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A Deep-Learning Based Approach To Bangla Currency Recognition in Real Time

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ABSTRACT(Optional)

Nowadays, researchers are trying to provide working solutions to the day-to-day problems faced by visually impaired people. Currency recognition using android phones can be a promising solution for visually impaired people for the safety and security during financial transactions. In this research work, We are going to implement a camera based system that can detect Bangladeshi currency automatically. Our goal is to use 2500 images to make the dataset. To design our model architecture, we are deploying the state of the art object detector model named YOLOv4. We will train our model using our Bangla currency dataset. Finally, we will deploy our trained model by developing an android application which will be user-friendly for the visually impaired people.

1. INTRODUCTION

1.1 Motivation

Our primary motivation was visually impaired people. There are so many people in our country who are totally blind or partially sighted. Some of them are blind by birth, some of them lost their sight due to accidents or injuries. According to research [1] 50–80% of blindness in this region are due to cataracts. Latest research of the World Health Organization (WHO) [2] reports that 253 million people are visually impaired globally and among them 36 million are blind and 217 million have moderate to severe vision impairment. From current estimation, Bangladesh has 6,50,000 blind adults aged 30 and over in Bangladesh, the large majority of whom are suffering from operable cataract [3].

While leading their daily life in society, visually challenged people face a terrible amount of challenges. This is because so much information is expressed visually. Among so many problems one of the major problems is knowing the value of the currency that they are currently holding in their hand. As nowadays transactions of currency are increased to a large quantity and most of them happen face to face, it is difficult for visually impaired people to know how much currency they are transiting. They may get fraud by dishonest people. Another problem suffered by a visually impaired person is to identify paper currencies. This is because of the similarity of paper size and texture between different banknotes. As currencies are the commonly used stuff in day to day life, recognising the value of the banknotes is a very essential task for them. Therefore, we have proposed a real-time system that will help them to recognize the currencies and resolve this crisis to make visually impaired people feel confidence in the financial dealings, not depending on others.

The United States is the only country that prints all denominations of currency in the same size. The US and Switzerland are the only two countries that use the same colors for all of their various bills. Needless to say, this similarity of size and color make it impossible for a blind person to locate the correct bills to make a purchase without some sort of assistance [4]. A blind person can identify paper currency by folding each denomination in different ways. Although the idea of folding the currency seems promising, it needs others' help to organize bills. The recent banknotes of Bangladesh

have blind embossing or blind dots, which could be effective to recognize the value of the bill by touching. As the embossing fades away in the long-term used notes, it is hard to identify the bank note after several uses [5]. Moreover, in a developing country like Bangladesh, visually impaired people fall victim to deception on a regular basis while transacting money. Therefore, to ensure safety and confidence during financial transactions conducted by visually impaired people, they need assistance from technology to recognize Bangla currency.

The main argument in this project is realization of deep-learning based currency recognition software. According to the procedure in this project and perform currency recognition step by step, it includes identifying the bank-note. In this report the following points are proposed :- (1.1) Motivation, (1.2) Social and Ethical Issues, (1.3) Sustainability Issues, (1.4) Related Work and Limitations, (1.5) Problem Statement, (1.6) Our Proposed Solution, (2) Background Study (Machine Learning and Deep-learning), (3) Related Work and Limitations, (4) Proposed Solution (Model Architecture), (5.1) Time Schedule (5.2) Budget, (6) Conclusion

1.2 Social and Ethical Issues

The term “visual impairment” is employed to explain a large number of conditions that have an effect on clarity of sight and field of sight. Visually impaired people have been deprived from society. Day to day life is not that easy for them. One of the daily matters they have to deal with is acknowledging the currency they are using. Though there are some ways imprinted in every Bangladeshi note to recognize the value just using our touch senses. But not everyone knows about it and it is hard to remember. Also the note can be damaged in a certain way, it can't be acknowledged.

Another Ethical issue sightless people have to face is getting defrauded by some ill intentioned people. It is a matter of mortification for our society. So, our approach on this issue using deep-learning algorithms can have a huge impact on society.

1.3 Sustainability Issues

At this moment there are so many systems or applications to detect and identify different types of currency. Several research happens to resolve this problem. The USA Department of Treasury invented a device that can detect currency. There are also some other apps available and these systems are able to give output in real time. But for Bangladeshi currency there is no well known, easy to use system. This is an opportunity for us to do something for our people. A large number of visually impaired humans face hassle in their daily lives during currency transactions. Our project can save their money from falling into the wrong hands.

This project can be well accepted by society and beneficial for the visually impaired. Day to day transactions can be easily done by this system. This type of system has side effects on the environment and the society. As we know coronavirus can spread through Bank Note. If visually impaired people use our app then they don't have to touch the Note to identify the value of that currency. This can help them prevent contamination of coronavirus. As Bangladeshi banknotes have blind spots, visually impaired people have to rub the note to understand it. If they don't have to do it then they can keep themselves away from lots of germs and bacteriae.

1.4 Related Work and Limitations

For this project, this report will read many research papers on currency recognition, object detection, image processing and edge detection(ORB). We tried to refer them into the reference section of this report. But we evaluate some projects and research papers on our own.

The paper we are trying to uphold here, are :- Prof. Sagar S.Rajebhosale [7], Sandeep Kumar Chaubey [8] and Md. Ferdousur Rahman Sarker [9]. All of these systems are well proposed and designed. But we found some relative issues that we are going to explain in a later segment of this report. And the project we are developing will overcome all these problems.

1.5 Problem Statement

An approach based on deep learning methodology to solve the currency recognition problem for the people suffering from visual impairment. A system that can recognize, identify and show real time results of the currency note of People's Republic of Bangladesh (TAKA).

Problem List :

1. Collecting data and labeling data
2. Design a model and train AI
3. App designing and development
4. App testing

1.6 Our Proposed Solution

Our proposed solution is to create an application on the Android platform. But before that we will develop a system that will be able to recognize currency with great accuracy. For this YoLo-v4 will be the best solution. It is faster than any other object detection algorithm.



Figure : A sample currency recognition system

Now our first task is to collect data and label data for training. Design a model for this specific task. After training and validation of the system, the testing phase will start. After that, we will design an android application that will be user friendly and free for everyone.

There are several tools and software will be used in this project. For the Artificial intelligence system our selected IDE is Google Co-lab. As the programming language we choose Python Tensorflow with Keras library. For app development we are going to use the programming language “Flutter 2.0” in Android Studio IDE.

Used Tools :-

1. Google Co-Lab
2. Android Studio

2. BACKGROUND STUDY

Machine Learning and Deep Learning

Machine learning is a methodology of data analysis that automates analytical model building. It's a part of artificial intelligence(AI) based on the idea that systems can learn from data, identify problems and can make decisions with less human intervention. It's the most important implementation of artificial intelligence.

There three types of Machine Learning Algorithms:-

1. Supervised Algorithms
2. Unsupervised Algorithms
3. Semi-Supervised Algorithms

Deep learning is a subfield of machine learning. Deep learning structures algorithms in layers to create an “Artificial Neural Network” that can learn and make intelligent

decisions on its own. Deep learning is to estimate the weights of each layer through a backpropagation algorithm. In artificial neural networks supervised learning(SL) and unsupervised learning(UL) are associated closely. We are going to use a deep learning tool “YoLo V4” for currency detection in an image.

3. Related Work

We search for research papers, projects and live software on the internet. We got so many results and trying to uphold few of them here ,

3.1 Related Paper and Limitation : A research paper called “Currency Recognition System Using Image Processing” was published by Prof. Sagar S.Rajebhosale [7]. In this paper the researchers proposed a system based on image processing. In this method input Image will be converted into digital form and then compared with the previously setup template. They propose to use a different system than the user. Users have to upload the image to a server, then the server will process it and return the result to the user.

This system is not fast enough, like, the total time for returning the result might take a while depending on the multiple variables. For example, users have to upload the image to the server then the server will process the image with various operations, compare with the database in the server and return the result to the user. In our observation, this is the main limitation of this system. It's not reliable because the main processing is not happening on the user's device.

3.2 Related Paper and Limitation : Sandeep Kumar Chaubey [8] submitted a report on “Currency Recognition System using image processing”. In this paper the

researcher uses image analysis , image processing and edge detection . Image analysis tasks such as reading bar-code tags or as sophisticated as identifying a person from their face.Edge detection is used in image analysis for finding region boundaries.

Researchers are using the MATLAB environment . MATLAB is a high level technical Computing language. It has a variety of API for image processing.

After analyzing their research paper we found some limitations: they use image processing , image analysis and edge detection which don't get a high percentage of accurate results. They use the MATLAB environment. Matlab is very complicated to use. Matlab is a confusing mixture of multiple programming languages like c, c++ and java. So manipulating this system is quite complicated in our observation.

3.2 Related Paper and Limitation : “Real-Time Bangladeshi Currency Detection System for visually impaired persons' ' named research paper was published by Md. Ferdousur Rahman Sarker [9]. In this paper, the researchers propose an image processing based system that will use Keypoints Detection. Their approach to the system is very impressive. The proposed system can be reliable and process time for each image will be fast because of ORB Keypoint detection.

After reading about their paper and researching their approach, we have found some slight limitations on this method. Though they train the neural network with ideal and distorted images, it still might have some issues. Though they used Keypoint Detection to make it fast ,but when the bank-note is folded Artificial Intelligence won't be able to find all the Keypoints. Hence, the result accuracy will decrease. Similar problems also can occur when the bank-note is stained.

4. PROPOSED SOLUTION

Model Architecture

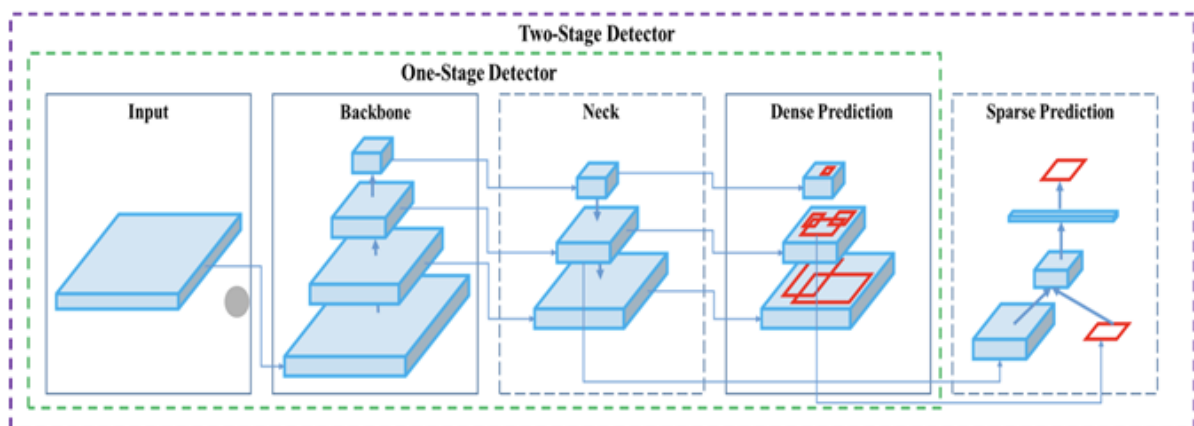
YoLo was originally authored by Joseph Redmon to detect objects. The full meaning of Yolo is “ You Only Look Once”. YoLo is a clever Convolutional Neural Network (CNN) for object detection in real time. With YOLO, a single CNN simultaneously predicts multiple bounding boxes and class probabilities for those boxes. YoLo trains on full images and directly optimizes detection performance.

YoLo-v4 model published in April 2020 and achieved state of the art performance in COCO dataset. It breaks the object detection task into two steps :

- Regression to identify object positioning through bonding boxes
- Classification to determine the object classes

Yolo-v4 outran all existing methods significantly in both terms detection performance and superior speed. The main objective is to optimize neural network detectors for parallel computation. Yolo-v4 consist of :

1. Backbone (CSPDarknet53)
2. Neck (Spatial Pyramid Pooling, PANet path aggregation)
3. Head (YoLo-v3)



5. Time Schedule & Budget

5.1 Time Schedule

Task List	Schedule(week)
Data Collection	Semester Break
Data Labeling	1 st
Model Designing	2 nd & 3 rd
Training and Validation	4 th & 5 th
Testing	6 th
Android App Development	7 th
Requirement Analysis	8 th
Implementation	9 th
Application Testing	10 th
Deployment	11 th
Book Writing	12 th , 13 th & 14 th

5.2 Budget

The type of our project is mostly software based. All the software and tools we are using for this project is rent free. So, we are not going to spend any money on this project. But we have to spend a lot of time on project development. But to fulfill the report requirement, we will calculate the hypothetical wages.

As a salary explorer, the average hourly wage in Bangladesh is 150 taka only. As our time schedule we have to work on this project for fourteen weeks. Hypothetically, if we engage for 3 hours each and 5 working days a week, total man hours will be 210 hours each. For each member of our team the wage will be 31,500 taka. So, the total budget for the project is 94,500 taka.

6. Conclusion

This paper proposes a project for recognizing currency using object direction from YoLo V4.as YoLo means “you only look once”, so we have a very good theory about this system faster than any other currency recognition software that has been released to the public until now. As we already declared that we will use flutter for the app development. So, we have a future plan to release this software for IOS based mobile devices.

Through this project, we will know more about object detection, application development and more importantly Team-Work. It will be the biggest and most complex project for our team until now.

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How Ps are addressed through the project and mapping

ps	Attribute	How Ps are addressed through the project	CO	PO
p1	Depth of Knowledge Requirement	<p>In this project we studied deep-learning system using Yolo-v4 model architecture for object detection (K8)</p> <p>Multi-layer of Engineering model design (K5)</p> <p>User interface Development (K6)</p> <p>Meeting , special lectures (K7)</p> <p>Knowledge of software engineering and app developing (K3), (K4)</p>	CO1, CO2, CO4, CO5, CO7, CO8	PO2, PO9, PO7, PO3, PO6, PO8, PO4, PO5, PO10,
p2	Range of Conflicting Requirement	Design an appropriate deep-learning model to detect objects from images of currency in different qualities.	CO1	PO9
p3	Depth of Analysis Required	Use Yolo-v4, a deep-learning system instead of image processing.	CO1, CO7	PO3, PO4, PO5, PO9,
p4	Familiarity of Issues	Image resolution has to be not more then 320*320 pixels	CO9	PO12
p5	Extent of applicable codes	Generate proper solution of deep-learning model after designing and validation	CO7	PO3, PO5, PO4,
p7	Interdependence	Image collection, image labeling, creating model, design app development	CO6, CO3, CO5	PO8, PO9, PO6, PO11,

How As are addressed through the project

As	Attribute	How As are addressed through the project
A1	Range of Resources	In the development stage, the project requires are :- Data : Image of all Bank-notes Technology : Yolo-v4, tensorflow People : Developers
A2	Level of Interaction	By using deep-learning model detect bank-notes from low to high quality images
A3	Innovation	A level of creativity is needed to develop the deep-learning based software using the available data and resources.
A4	Consequences for society and the environment	Will be very beneficial for visually impaired people and can be used in many type of application for the society
A5	Familiarity	This project will to empowerment of visually impaired people