

Smart Road AI Damage Classifier and Issue Tracker

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Abstract - Keeping roads maintained by hand is really slow and messy. This causes safety worries and delays repairs. The YOLOv8 model is used in this system to spot potholes and cracks and uneven pavement. It does this accurately. Then it helps manage them. The system saves damage reports in MongoDB. These reports use images and location and severity. This simplifies management. City leaders can see information on one dashboard. They use this to decide which repairs to fix first. The YOLOv8 model system automates the process from spotting problems to taking action. This means the system uses resource better. It improves accountability. The YOLOv8 model system helps build city infrastructure that uses artificial intelligence.

Keywords - YOLOv8, Road Damage Detection, Deep Learning, Smart Cities, Automated Infrastructure Management, MongoDB.

I. INTRODUCTION

Roads are really important for people and the economy. Taking care of them is a big problem for cities and towns. Usually when there is a problem with a road people with a road people have to tell someone about it and then wait for something to be done. This can take a time because of a lot of paperwork and not knowing what is going on. This means that roads can stay broken for a time, which is bad for cars and can even be dangerous although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow. To make this better we want to create a system that can find problems with roads and make it easier to complain about them. This system uses a kind of computer program called YOLOv8 that can look at pictures of roads and find problems like potholes. It can even use the location of the problem to tell the people about it. This way when someone

reports a problem the system can help figure out how bad it is and where it is so the people in charge can fix it sooner. This will help make sure that roads are safe and that the people, in charge are using their time money wisely to keep the roads in shape. The Road Damage Detection and Complaint Management System is what we call this way of doing things.

II. LITERATURE SURVEY

The switch from road checks to automated computer vision is a big change in how we take care of urban infrastructure. This part looks at the research in object detection and system architecture that the Smart Road AI framework is based on. [1] Evolution of Detection Models: In the past monitoring roads was done by people who would look at the roads and write down what they saw. This method often gave us information. Some researchers, like Maeda and his team used a set of data called RDD2022 to show how deep learning models can work well in different environments. Earlier models like YOLOv5 were fast. Newer models like YOLOv8 are better at finding problems on the road because they do not use anchors. This means they can find issues like alligator cracks and potholes that older models might miss. [2] Performance and Latency Optimization: It is very important to process information so we can keep people safe in real time. Even though Tsinghua University came up with YOLOv10 to make some parts of the process faster YOLOv8 is still the choice for monitoring infrastructure because it is very stable. Using a framework called PyTorch helps the system work fast so the time between finding a problem and telling the people in charge is almost zero. [3] Full-Stack Data Orchestration: What the researchers are

saying is that an AI model is only as good as the data it is working with. Kaiser and Deb found out that AI tools do not work well in the run if they do not have a good way to report what they find. They think we should use something called a stack, which includes MongoDB, Express, React and Node.js to manage a lot of unstructured image data and real-time information. This makes it possible to switch from paper records to an visual dashboard that city officials can use. [4] Geospatial Automation: It is very important to include location information for the system to work well. Smith and Johnson said that when people report problems it is often hard to figure out where the problem is, which makes it hard for repair crews to find it. By using the Google Maps API to add location information to every report the Smart Road AI framework creates a map of the infrastructure that updates itself. This makes it easier to fix problems and reduces mistakes during the repair process. The Smart Road AI framework is, about using computer vision to take care of urban infrastructure and the Smart Road AI framework is what makes this possible.

III. METHODOLOGY

The Smart Road AI framework is made up of parts that work together to connect computer vision and cloud management. This system has a set of steps it follows starting with collecting data and ending with people in charge making sure everything runs smoothly.

A. System Architecture

The Smart Road AI system is built on a three-part structure. It helps connect real-time data collection to action. The front-end part captures high-resolution images. It uses google maps to add locations details to each report. The raw data is sent to the processing core. A YOLOv8 model is used here to identify road defects and assess how severe they are. The system uses a MongoDB Database to store damage reports. This allows for retrieval of data. An administrative dashboard displays this data on a map. This helps municipal authorities see the information easily. The detection engine and management portal are separate. This means the system can handle users reporting at the same time. The Smart Road AI framework is designed to make data collection and administrative action work smoothly.

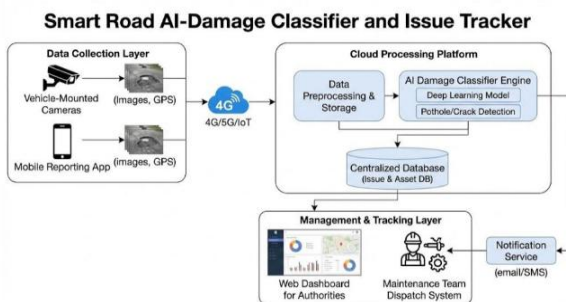


Figure 1. System Architecture

B. Logic Flow

The system works in a line to make sure data is good and repairs are taken care of automatically. When it starts the

system connects to the video source. Begins looking at pictures in real-time. As the data moves through the system the YOLOv8 engine looks at each picture to find road problems and see how bad they are. If the damage is too much the system sends out an alert, which includes a picture of the problem and its location. This information is then added to the cloud database so people in charge can see the problem right away. As the city teams fix these problems the system keeps track of what's happening from the time it is reported to the time it is fixed making a digital record of how good the city's infrastructure is.

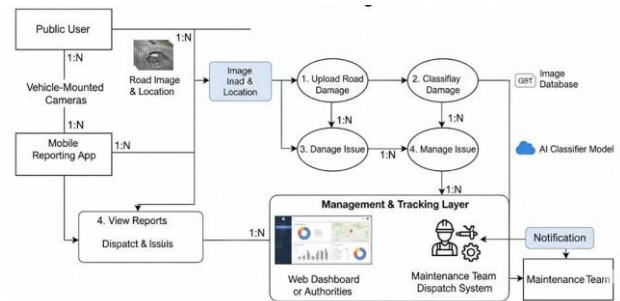


Figure 2. Flow Chart

C. Algorithmic Implementation

The Smart Road AI framework works because of the core intelligence that comes from a bunch of algorithms that work together. These algorithms handle things like computer vision and managing data in the cloud.

1. YOLOv8 Object Detection Logic: The system uses YOLOv8 to find things like potholes and cracks. This is a way to do it because YOLOv8 is really fast and accurate. It looks at the video. Finds these things in just one pass. This means the system can look at video and find problems without slowing down.

2. Confidence. Validation: The system has a filter to make sure it does not send out alarms. It only sends out alerts when it is really sure it found something. When it finds a problem it gives it a label and a percentage score. This helps figure out how bad the problem is. The system puts problems into categories like Low, Medium or High priority. This way only the big problems get sent to the city to fix.

3. MERN-Based Data Synchronization: The system uses something called MERN to store data. When the system finds a problem it sends the picture, how bad the problem's when it happened to the cloud. This way the data is safe. The people in charge can see it right away.

4. Geospatial Coordinate Resolution: While the system is looking for problems it also figures out where they are. It uses the devices GPS and Google Maps to get the location. This means the repair crews can find the problems easily and fix them fast. The Smart Road AI framework is about making it easy to find and fix problems on the road. The core intelligence of the Smart Road AI framework is really important, to making this happen.

IV. RESULT

The Smart Road AI system works from start to finish. It combines learning with web technologies effectively. The results on the screens show that it operates efficiently and detects things accurately. It gets marks, for efficiency and precision. The systems interfaces are easy to use. The results are good. That's what matters.

Figure 3. shows the first part of getting the system up and running was to create a landing page that people can use easily. This landing page is for everyone to report things and for administrators to use. The system overview shows that the interface is easy to use and gives people a way to add information. This makes it easy for people to switch from making a complaint by hand to using the system with artificial intelligence, which is the complaint report system. The complaint report system is designed to be easy for the general public to use.

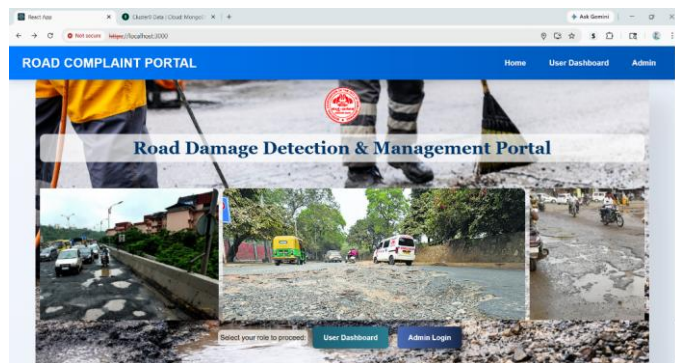


Figure 3. Home page

The Figure 4. Shows the user dashboard, where users can upload road damage images either from their device or by capturing them using the camera. It provides a simple interface to submit complaints and track their applications status.

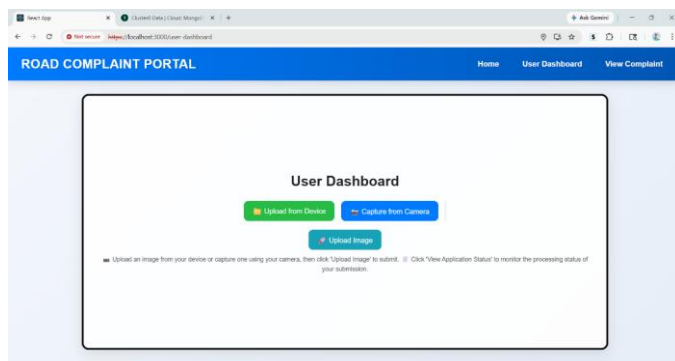


Figure 4. User dashboard

When the system finds a problem it starts to figure out what kind of problem it is and writes it down. The test results show that the system is good at putting problems like "Pothole" into categories and saying how bad they are which can be Low, Medium or High. It does this by looking at what the problem looks like. Then it shows all this information in a format so the people in charge can see what is wrong and when it happened and they can make a list of

what needs to be fixed first. The system is really good at helping authorities see what problems need to be fixed and the system shows the problems in a list so they can fix the problems, like "Pothole" first.

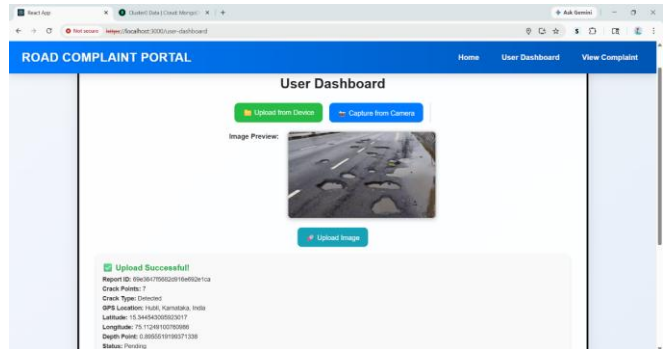


Figure 5. Image upload in user dashboard

A big benefit of our system is that it automatically connects evidence to a specific geographic location. In the test we saw that for each image uploaded the system finds and shows the exact coordinates on a map using Google Maps. This makes it easy for municipal teams to see where road defects are as they can view them on a map. The "View on Map" feature helps turn data into a clear plan, for fixing roads. With this teams can easily visualize how road defects are spread out.

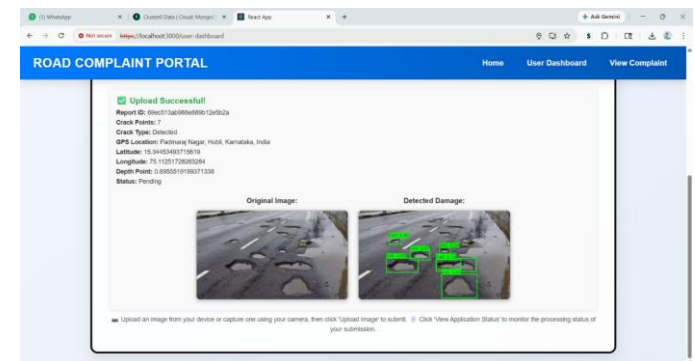


Figure 6. Result of uploaded image processing

The Figure 7. Shows the admin login page, where administrators enter their credentials to access the system. It provides a secure interface for authorized users to manage and monitor reported road complaints.

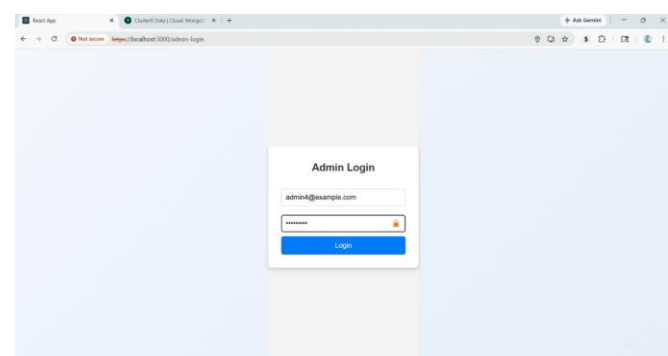


Figure 7. Admin login page

The results show that logging defects in a way helps. It lists defects like "Pothole" and "Longitudinal Crack" clearly. This makes it easy to track and review. Each complaint in the table has details. These include a Complaint ID, the severity level which can be Low, Medium or High and the exact time it was reported. Organizing data this way makes it easy to filter and search. Authorities can then focus on damage in different areas. They can target "Pothole" complaints in one zone and "Longitudinal Crack", in another. This helps them fix issues faster.

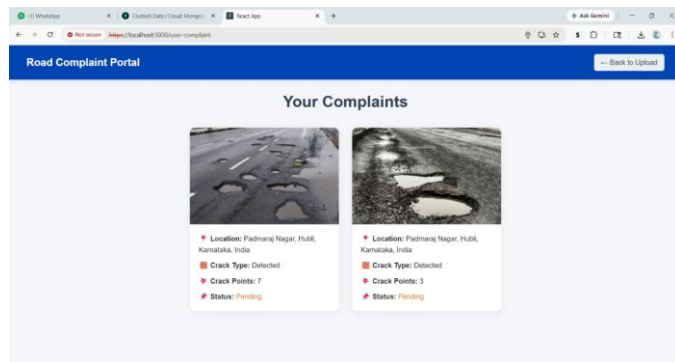


Figure 8. Complaint portal

The picture (Figure 9.) shows the Complaint Management page, which's like a big list for all the road problems that have been checked by artificial intelligence. Each problem on the list has a number, the name of the person who reported it and what kind of damage it is, which the YOLOv8 engine found. The system also shows what is happening with the problem now and has a link to see the problem on a map. This helps the people in charge go from collecting information to actually fixing the problems so they can make sure every issue is written down and taken care of and everyone knows who is responsible, for fixing it.

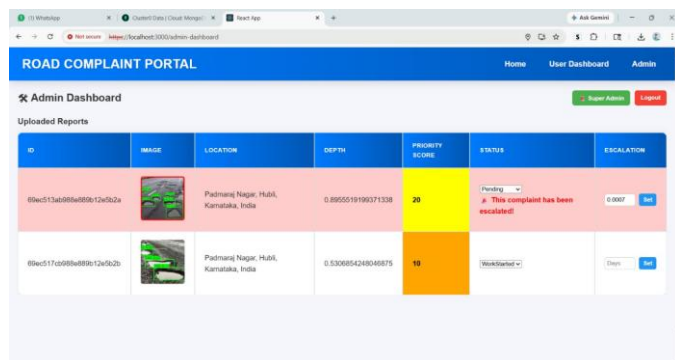


Figure 9. Uploaded reports

The Emergency Escalation feature in the Super Admin dashboard is made to find and prioritize road defects that can hurt people. When the system finds bad damage like big potholes on busy roads it marks the report as an Emergency. This means it gets fixed away and does not have to wait in line. The Super Admin can then send repair crews to fix the problem fast as possible. This helps keep people safe and fixes problems with the roads quickly. The Emergency Escalation feature is important because it helps the Super Admin deal

with Emergency situations, like road defects and get them fixed with the Emergency Escalation feature.

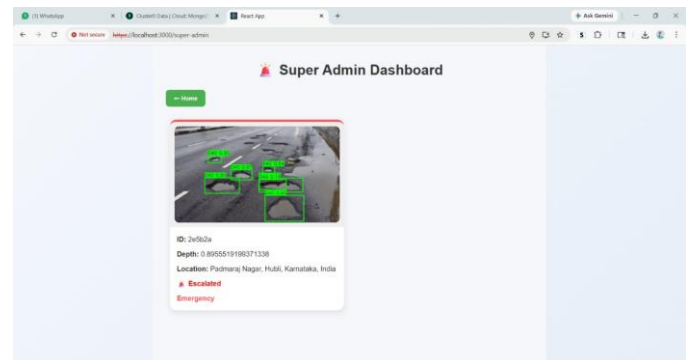


Figure 10. Super admin dashboard

V. CONCLUSION

The Smart Road AI framework changes how we manage roads by combining computer programs with cloud technology. This replaces manual checks that are not always consistent. The framework provides a system that can easily grow to help find defects and map how bad they are. This helps cities respond faster and keeps people safer. The Smart Road AI framework is important for building smart cities and a new standard for keeping roads in good condition. It helps make road maintenance strong and reliable.

VI. REFERENCES

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