SMART ENERGY METER DATA COLLECTION USING IMAGE PROCESSING AND IoT

Mini-Project Report submitted to the SASTRA Deemed to be University in partial fulfillment of the requirements for the award of the degree of

B. Tech. Electronics and Communication Engineering

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THANJAVUR – 613 401

Bonafide Certificate

This is to certify that the report titled "**Smart Energy Meter Data Collection Using Image Processing and IoT**" submitted in partial fulfilment of the requirements for the award of the degree of B. Tech. Electrical & Electronics Engineering to the SASTRA Deemed to be University, is a bona-fide record of the work done by **Ms. Darsna S**(Reg. No.:126004062), **Ms. Ujwala Reddy**(Reg. No.:126004161), **Ms. Subasri B**(Reg. No.:126004268)during the Sixth semester of the academic year **2024-25**, in the **School of Electrical & Electronics Engineering**, under my supervision. This report has not formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title to any candidate of any University.

Signature of Project Supervisor :

Name with Affiliation :

Date :

Project *Viva voc*e held on ________________

Examiner 1 Examiner 2

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Declaration

We declare that the report titled "**Smart Energy Meter Data Collection Using Image Processing and IoT**" submitted by us is an original work done by us under the guidance of **Dr.R. Sriranjani, Sr. Asst. Professor School of Electrical and Electronics Engineering, SASTRA Deemed to be University** during the Sixth semester of the academic year **2024-25**, in the **School of Electrical and Electronics Engineering**. The work is original and wherever we have used materials from other sources, we have given due credit and cited them in the text of the report. This report has not formed the basis for the award of any degree, diploma, associate-ship, fellowship or other similar title to any candidate of any University.

Signature of the candidate(s) :

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Finally, we express our heartfelt thanks to all who contributed directly or indirectly to the completion of this project.

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Abstract

This project is to address the problem of taking the energy meter reading manually which are more likely to be subjected to error and inaccurate making the energy management less reliable. As the existing research papers have used large dataset for training and Zigbee modules which are not widely available nor cost effective. Our project automates this process using image processing and IoT. We capture the meter readings under various lighting environment and conditions, processed them in MATLAB to enhance contrast using adaptive histogram equalization, and applied OCR to the image to accurately extract readings. The extracted data was then converted into matrix format and transmitted to the THINGSPEAK cloud platform which is available in Simulink MATLAB. Then through a Simulink model for real-time monitoring and storage.

Specific Contribution

- Collected the dataset by capturing multiple energy meter images under different lighting and environmental conditions.
- Developed an automated meter reading system using image processing.
- Operated the Simulink model to send the processed readings to the ThingSpeak cloud platform.

Specific Learning

- Gained hands-on experience with MATLAB image processing techniques.
- Learned how OCR works for extracting numerical readings from real-world images.
- Understood how to integrate MATLAB and Simulink with ThingSpeak for realtime cloud data storage.
- Learned how to tackle challenges like inconsistent lighting and different meter display types to maintain the system's performance.

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Abstract

Intelligent system and energy management emphasis has developed sophisticated monitoring technologies. In contrast to the old energy meters, new ones incorporate remote data analysis and real-time monitoring. The recent advancement of image processing in conjunction with IoT cloud platforms has fully automated energy management. In this project, our goal is to incorporate IoT and cloud technologies for stream-based monitoring and controlling energy systems using MATLAB image processing. The system scans meter readings using imaging and stores them in MATLAB as image matrices using sophisticated algorithms. A Simulink model directs the data to the cloud where it gets logged, analyzed, and displayed in real time using an interface with ThingSpeak. The system also sends digital updates to energy meters such that real time cloud monitoring is affordable. This project suggests a holistic and automated approach to monitoring energy consumption, which holds immense potential for energy auditing and management.

Specific Contribution

- Used image processing (filtering, sharpening) to enhance meter reading accuracy.
- Integrated ThingSpeak with Simulink for real-time cloud data transmission.
- Optimized and tested the ThingSpeak channel for reliable data logging.

Specific Learning

- Gained expertise in image processing (noise reduction, edge sharpening) for accurate meter reading extraction.
- Learned to integrate ThingSpeak with Simulink for real-time cloud data transfer.
- Gained skills in optimizing and troubleshooting IoT data channels for reliable logging.

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Abstract

The versatility of automated energy meter reading is expected to significantly improve the efficiency and accuracy of energy consumption management. Manual readings are always prone to mistakes and delays, rendering data unreliable and possibly inaccurate. Past researchers have studied automation for meter reading using image processing and optical character recognition (OCR). This project seeks to address those problems through digital image processing and cloud storage of energy meter readings. The system pictures an energy meter, enhances the visibility of the image through MATLAB, reads the numbers and units by OCR, simulates the system on ThingSpeak in Simulink, which sends data to the cloud for storage via the ThingSpeak output block diagram, and directs the data towards the IoT cloud platform for real-time monitoring and storage. Testing with the developed system was performed under different lighting and meter display conditions, and promising results were observed in favour of system accuracy. The results show the prospect for error reduction in the meter reading and, hence, remote monitoring of energy consumption.

Specific Contribution

- Developed an automated meter reading system using image processing.
- Applied image enhancement and OCR in MATLAB.
- Integrated ThingSpeak for real-time monitoring and cloud storage.

Specific Learning

- Gained experience in digital image processing using MATLAB.
- Learned to apply optical character recognition (OCR) for data extraction.
- Integrated ThingSpeak for real-time monitoring and cloud storage**.**

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Name: Dr. R. Sriranjani, SAP/SEEE | Name: M. Ujwala Reddy

List of Figures

ABBREVIATIONS

MATLAB	Matrix Laboratory
OCR	Optical Character Recognition
kWh	Kilo Watt Hour
AMR	Automated Meter Reading
IoT	Internet Of Things
API	Application Programming Interface

CHAPTER 1

INTRODUCTION

1.1 Overview:

Manual energy meter reading methods are inefficient, error-prone, and time-consuming. In traditional systems, human errors, delays, and inconsistencies often lead to unreliable energy consumption data. Although Automated Meter Reading (AMR) systems have been introduced to address these issues, they generally require replacing conventional meters with smart meters or integrating additional hardware modules such as ESPs, which increases the overall system cost and generates electronic waste. In contrast, our project proposes a sustainable, low-cost solution that automates the energy meter reading process by using image processing techniques on existing conventional meters. By capturing the image of the meter and processing it through MATLAB, we accurately extract the meter reading without the need for any hardware modification. The extracted readings are then transmitted to the ThingSpeak cloud platform through a Simulink model for real-time monitoring and data storage. This approach not only enhances the accuracy and efficiency of meter reading but also promotes environmental sustainability by minimizing electronic waste and making efficient use of existing infrastructure.

1.2 Problem Statement:

Manual methods of recording energy meter readings are labour-intensive and prone to human errors, resulting in inaccurate billing and energy management issues. Although AMR technologies provide automation, they often require significant investments in additional hardware or complete meter replacement. This results in increased deployment costs and contributes to electronic waste generation. Therefore, there is a pressing need for a solution that can automate energy meter reading directly from existing conventional meters without introducing additional hardware components.

1.3 Motivation:

The motivation behind this project is to design an energy-efficient and cost-effective automated meter reading system that leverages image processing techniques. By working with the already installed conventional meters and avoiding the addition of new electronic modules, the project reduces implementation costs and minimizes the environmental impact associated with e-waste. It also ensures that energy monitoring can become more accessible and sustainable, helping both utilities and consumers to better manage energy resources without investing in expensive smart meter upgrades.

1.4 Objectives:

The objective of this project is to automate the process of energy meter reading using image processing techniques without replacing or modifying conventional energy meters. By capturing images of existing meters and processing them through MATLAB to extract the numerical readings using Optical Character Recognition (OCR), the system enables automated meter reading without requiring additional hardware installations such as ESP modules. The extracted readings are transmitted to the ThingSpeak IoT platform via a Simulink model for real-time monitoring and cloud storage. This promotes a sustainable approach to energy management by extending the life and usability of conventional meters, rather than replacing them with costly smart meters.

1.5 Organization of the Report:

Chapter 2 presents the literature survey conducted to understand the existing approaches for automated energy meter reading and highlights the gaps that this project addresses. Chapter 3 describes the methodology followed, including the dataset collection, preprocessing of images, OCR extraction of readings, and the integration of extracted data with the ThingSpeak IoT platform through Simulink. Chapter 4 details the experimental setup, Simulink configuration, and procedures involved in transmitting the data to the cloud. Chapter 5 discusses the results obtained from different experimental conditions and analyses the system’s performance and reliability. Chapter 6 concludes the project with a summary of the key findings and suggests future directions for further enhancement of the system.

CHAPTER 2

LITERATURE SURVEY

Here, in this chapter, we will discuss current research in automated energy meter reading systems from the perspective of how optical character recognition (OCR) and digital image processing have been used to enhance accuracy and efficiency. We will describe several methods that have been tried in the past, such as problems faced by researchers, for instance, lighting conditions, different meter types, and ensuring accurate readings.

In their paper "Automatic Meter Detection and Recognition" in IJRASET, 2023, Maheshwari U. and Singh K. suggested an automatic system to identify and recognize energy meter readings. The authors employed sophisticated image processing methods to identify the meter display region precisely and used OCR algorithms to read numerical values with high accuracy. Their method sought to mitigate challenges such as differences in lighting, angle, and meter types, eventually enhancing the efficiency and reliability of meter reading operations. This work makes meaningful contributions towards minimizing manual labour and facilitating brighter, automated energy monitoring solutions.

Priya B.L. and Dhenakaran S.S. (2018) in their article "New Approach for Text-Based Image Compression" from IJSRST proposed a new method of compressing images consisting mainly of data which is textual. Their strategy was mainly around maintaining the readability and lucidity of text while attaining high compression ratios. By maximizing both the encoding process and storage, the new method intended to maximize efficiency in text-image transmission and storage without significant loss of quality, which made it very appropriate in document digitization and archival systems.

Manisha V. Shinde and Pradip W. Kulkarni (2014), in their paper "Reading of Energy Meter Based on Image Processing Technology" read at Technovision-2014, was all about an approach to automate energy meter reading through image processing methods. Their approach was aiming at taking snapshots of meter screens, preprocessing the images to clarify them, and using character recognition algorithms to determine the numeric readings. Its focus was to reduce human errors, eliminate manual efforts, and provide quicker, more precise meter data acquisition for utility management.

In 2023, Muhammad Imran and his colleagues developed a clever method to automate energy meter reading through deep learning. In their paper, "Image-Based Automatic Energy Meter Reading Using Deep Learning" in Computers, Materials & Continua, they employed the YOLO object detection model to detect and identify digits from energy meter images, even when the images were blurry, skewed, or dimly lit with at most accuracy rate. They trained their system using more than 10,000 images and achieved a whopping 98% accuracy. Their research speeds up meter reading, makes it more consistent, and much less labour-intensive, bringing us a step closer to completely automated and intelligent energy management systems.

CHAPTER 3

EXPERIMENTAL SETUP

In this chapter, experimental setup, processes, and methodologies employed to test and evaluate automated energy meter reading systems are explained in detail. The chapter gives a detailed description of experiments performed, such as image acquisition, preprocessing, optical character recognition (OCR), data transmission, and testing under different conditions.

3.1 Dataset Collection:

Images of conventional energy meters were collected to create a dataset for testing the system. Photographs were taken using a smartphone camera under various lighting conditions, including bright sunlight, low indoor lighting, and moderate ambient light. The dataset included meters of different designs (digital and analog) to ensure the system could adapt to variations commonly found in real-world scenarios.

Special care was taken to capture images with slight tilts, reflections, and minor obstructions to test the robustness of the image processing and OCR techniques.

Figure 3.1 shows the sample image of Energy Meter (Captured under Normal Lighting).

Figure 3.2 shows the sample image of Energy Meter (Captured under Low Lighting).

Figure 3.3 sample image of Energy Meter (Different Display Type).

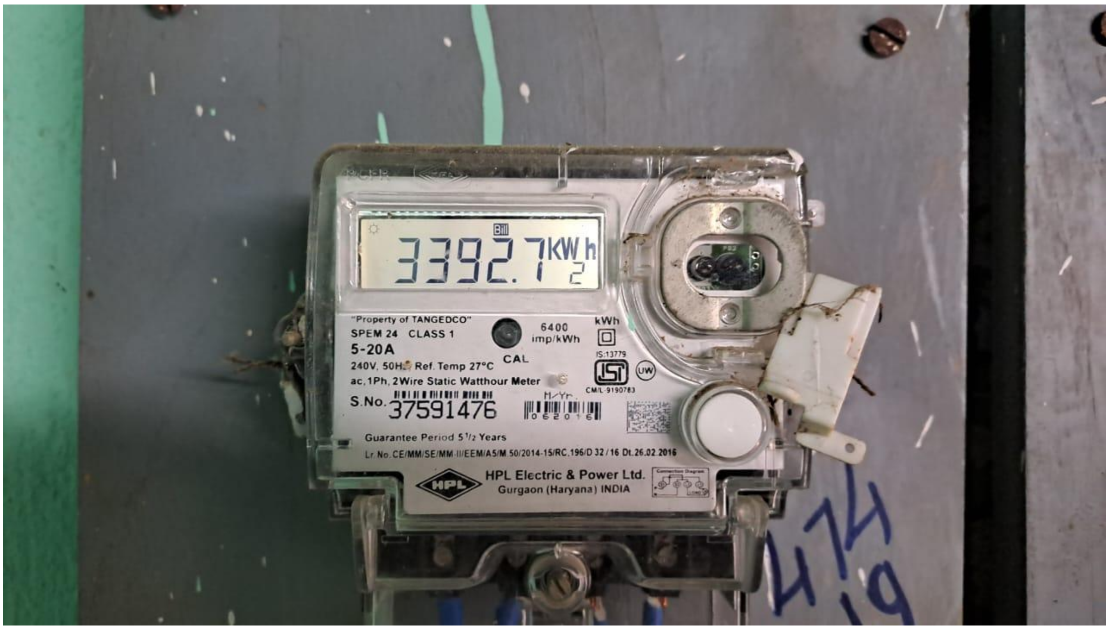

Fig: 3.1 Sample Image of Energy Meter (Captured under Normal Lighting)

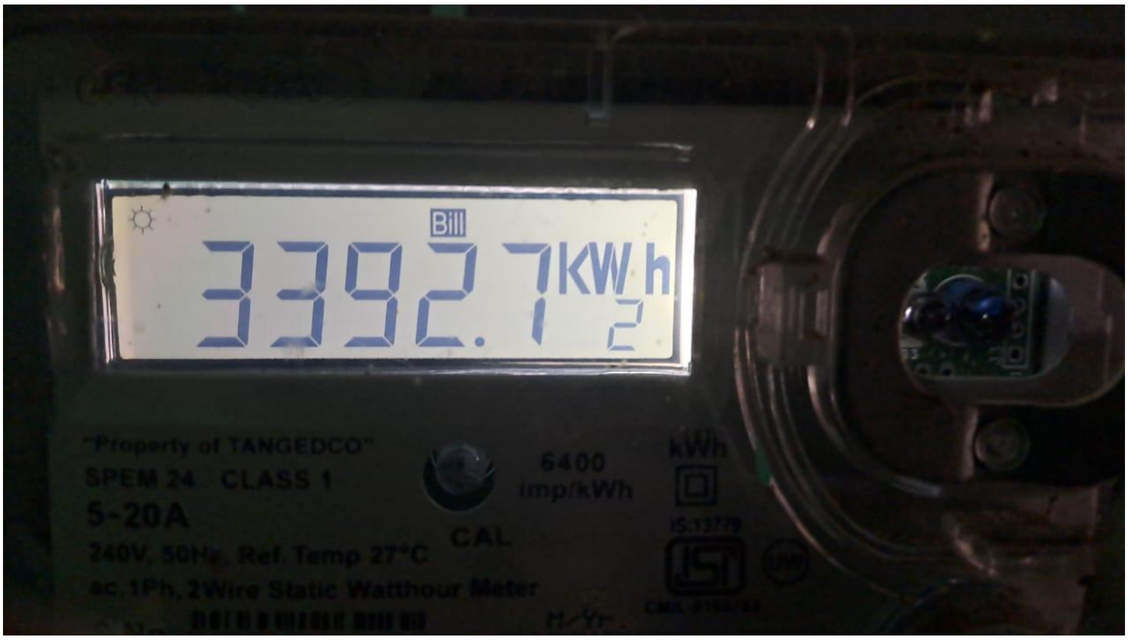

Fig: 3.2 Sample Image of Energy Meter (Captured under Low Lighting)

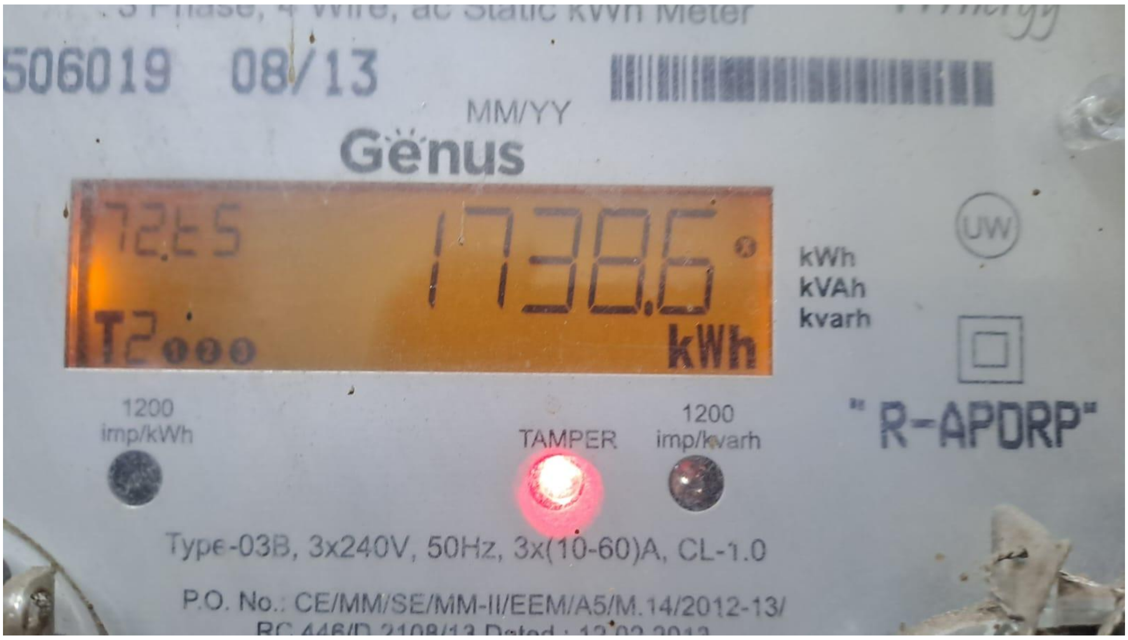

Fig: 3.3 Sample Image of Energy Meter (Different Display Type)

3.2 Image Preprocessing:

The captured images were subjected to a series of preprocessing steps using MATLAB to enhance the clarity and visibility of the digits displayed on the energy meters. The key preprocessing operations performed were:

- Grayscale Conversion: Reducing the complexity of the image by converting it from RGB to grayscale. Figure 3.5 shows Filtered Image.
- Contrast Enhancement: Improving the visibility of digits using adaptive histogram equalization techniques. Figure 3.6 shows the Enhanced and Sharpened Image.
- Noise Reduction: Removing unwanted background noise using median filtering. Figure 3.7 shows the Cropped ROI.
- Binarization (Thresholding): Converting the grayscale image into a binary (black and white) image to make the digits stand out clearly against the background. Figure 3.8 shows the Binarized Image.

These preprocessing steps were crucial to improving the performance and accuracy of the OCR process.

Figure 3.4 shows the Block diagram for Image Processing.

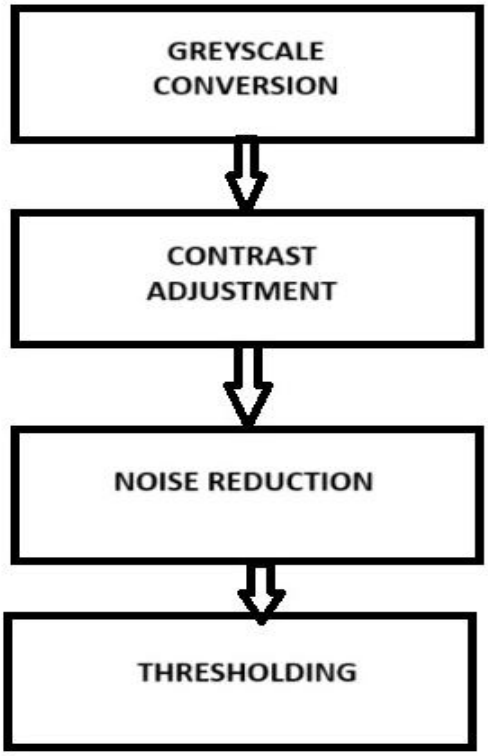

Fig: 3.4 Block diagram for Image Processing

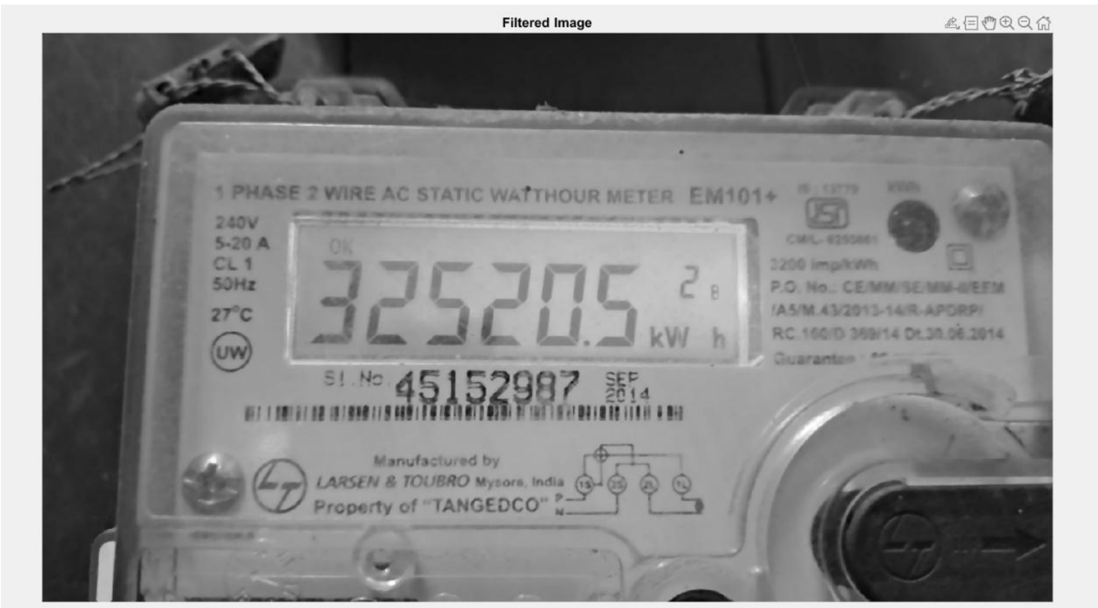

Fig: 3.5 Filtered Image

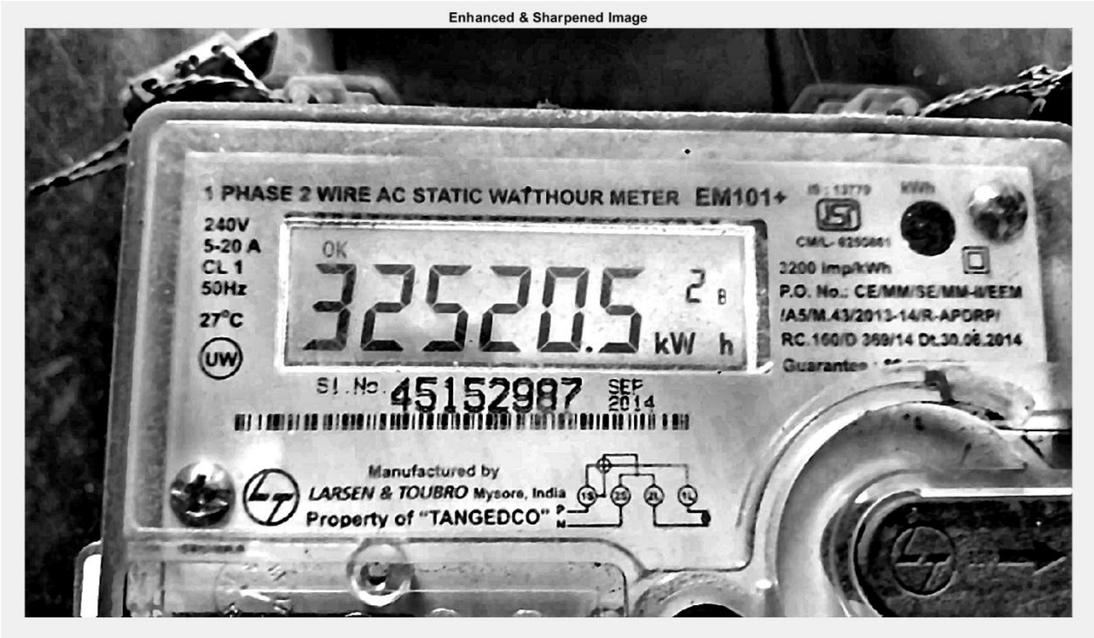

Fig: 3.6 Enhanced and Sharpened Image

Fig: 3.7 Cropped ROI

Fig: 3.8 Binarized Image

3.3 Optical Character Recognition (OCR):

When the photographs were taken, they went through Optical Character Recognition (OCR) to extract numerical readings and units from energy meters. OCR had been taught to identify:

Meter Readings: Digits written on the meter (e.g., "2345").

Units: Typical units such as "kWh" (kilowatt-hour), "V" (voltage), and similar normal units seen on meters.

We tried the OCR on many different meters with various fonts, configurations, and digit sizes to ensure that it would work on all types of designs. To ensure how well it performed, we compared the OCR readings to hand readings and checked for discrepancies and made changes as needed to enhance accuracy.

Figure 3.9 shows the OCR performed on the captured image.

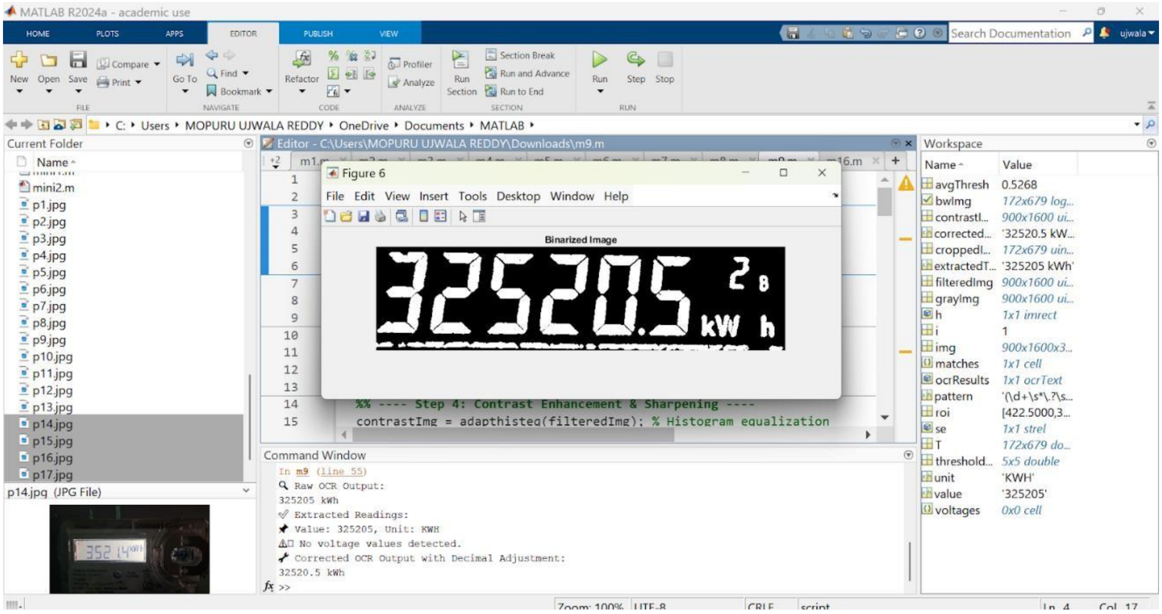

Fig: 3.9 OCR performed on the captured image

3.4 Conversion of Extracted Reading into Matrix:

After the numerical reading was extracted through OCR, the recognized value was first displayed in the **MATLAB Command Window** for verification. This immediate display allowed confirmation that the OCR process had correctly identified the meter reading from the captured image.

Once verified, the extracted reading was **manually converted into a matrix format** within the MATLAB workspace. This conversion was necessary because subsequent steps required the data to be organized in matrix form for compatibility.

The conversion was performed using a simple MATLAB command:

a = [1, value];

where value represents the extracted numerical meter reading.

Here, 1 act as a placeholder for the X-axis (sample number), and value corresponds to the Y-axis (the meter reading) when the data is uploaded or visualized later.

This matrix format structured the data appropriately for further processing and integration with the Simulink model in the subsequent stage.

3.5 Conclusion:

This chapter detailed the methodology followed for developing the automated energy meter reading system. It began with dataset collection involving real-time images of conventional energy meters captured under varying lighting conditions. These images were preprocessed using MATLAB techniques such as grayscale conversion, contrast enhancement, and noise reduction to improve clarity. Optical Character Recognition (OCR) was then applied to accurately extract the numerical readings from the processed images. The recognized values were verified through MATLAB's Command Window and subsequently converted into matrix format for further processing. The structured methodology ensured reliable extraction of meter readings and prepared the data for real-time cloud integration, which is discussed in the following chapter.

CHAPTER 4

SIMULINK INTEGRATION AND ThingSpeak INTEGRATION

4.1 Experimental Setup:

The system was designed to automate the process of energy meter reading using digital image processing techniques and cloud integration. The experimental setup includes a conventional energy meter, a camera for image capture, a computer system with MATLAB and Simulink installed, and an active internet connection to communicate with the ThingSpeak cloud platform.

The images of the energy meter were captured in different lighting conditions and processed in MATLAB to enhance visibility and accuracy. Preprocessing steps such as contrast adjustment, noise reduction, and binarization were applied before extracting numerical readings using Optical Character Recognition (OCR).

4.2 Simulink Block Diagram:

After successful extraction of the meter readings in MATLAB, the values were transferred to ThingSpeak using a Simulink model.

The Simulink block diagram consists of the following elements:

- From Workspace: This block fetches the extracted meter reading stored as a matrix variable in MATLAB workspace.
- Data Type Conversion: Converts the meter reading into a format compatible with the ThingSpeak output requirements (usually double data type).
- ThingSpeak Write Block: This block connects to the configured ThingSpeak channel and uploads the meter reading data.

The block diagram can be summarized as:

From Workspace ➔ Data Type Conversion ➔ ThingSpeak Output

Commands used to open and run the Simulink model:

open_system('C:\Users\MINIPROJECT\OneDrive\Documents\MATLAB\thingspeaktest12.slx');

sim ('C:\Users\MINI PROJECT\OneDrive\Documents\MATLAB\thingspeaktest12.slx');

This ensured that the extracted readings were sent automatically to the cloud without manual intervention.

Figure 4.1 shows the Simulink Block Diagram.

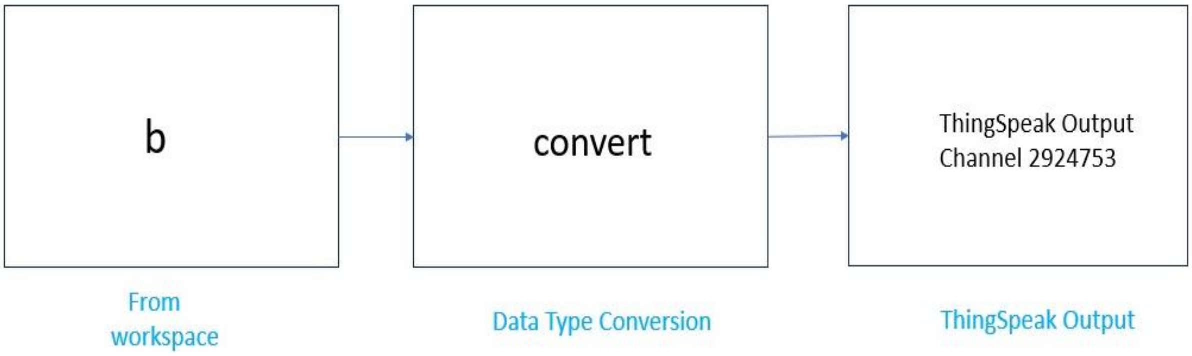

Fig: 4.1 Simulink Block Diagram

4.3 Channel Configuration:

The ThingSpeak Channel ID used was 2924753.

Key configuration details were:

- Field 1: Meter Reading Value
- Write API Key: Unique code used to authenticate and push data securely.
- Update Interval: Configured to allow regular updates as per the reading frequency.

This setup ensured that every new reading extracted via MATLAB was updated in real-time on the cloud platform.

Figure 4.2 shows the Channel Configurations.

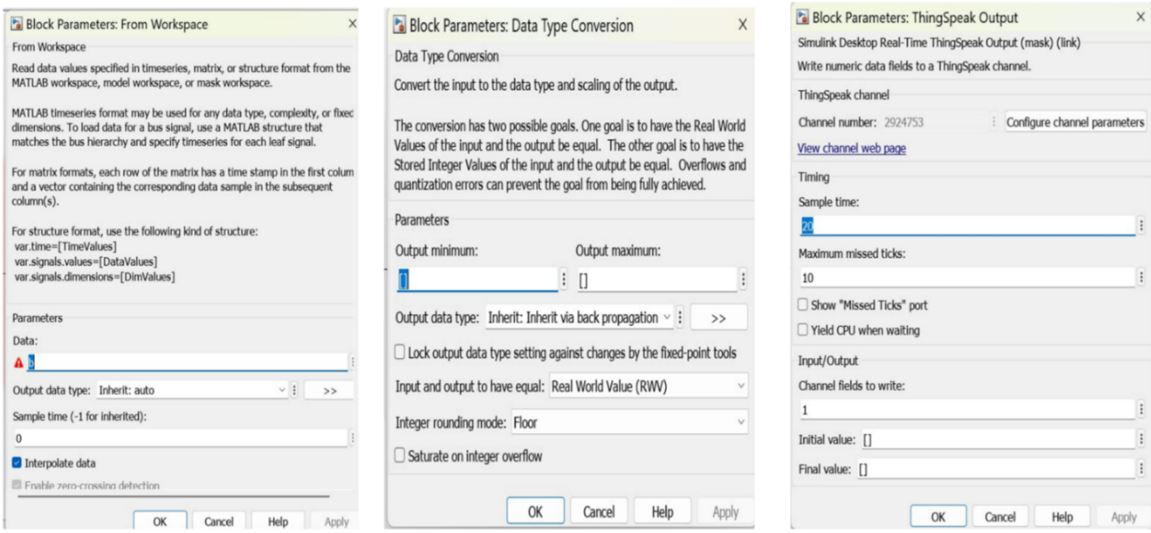

Fig: 4.2 Channel Configurations

4.4 Cloud Storage Using ThingSpeak:

ThingSpeak was utilized as the IoT platform for real-time storage and visualization of energy meter readings. Once the readings were uploaded through Simulink, they were plotted in graphical form automatically on the ThingSpeak dashboard.

The stored data could be accessed anytime remotely, allowing users to monitor energy consumption trends and perform analysis. This integration not only ensured remote accessibility but also added an important feature of real-time data logging and history tracking. The real-time plot of meter readings on ThingSpeak showed the progression of values.

For each reading sent, a corresponding point was plotted against the timestamp on the graph. This helped in tracking energy consumption behavior visually and spotting patterns such as sudden increases or gradual usage trends.

Sample view on ThingSpeak:

- X-axis: Time and Date
- Y-axis: Energy Meter Reading (units)

Figure 4.3 shows the Data storage in ThingSpeak.

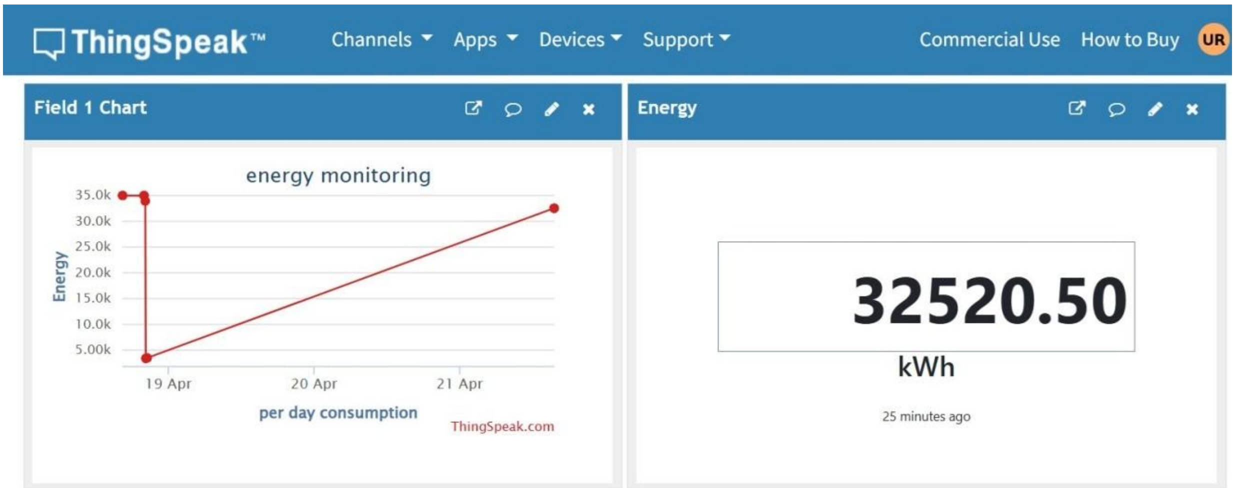

Fig: 4.3 Data storage in ThingSpeak

4.5 Performance Measurement:

3 major parameters were used to find out the functional efficiency of the system:

Accuracy: The hand reading from a meter was compared with that of a system reading. It serves the basic purpose of finding out how often the system is accurate.

Speed: The more rapid transfer to ThingSpeak, the more speed it can accommodate in handling the data.

Reliability: Several types of meters and light conditions were used to check and see how reliable it was. We checked if the system possible gives an accurate reading all the time, regardless of conditions.

In overall, the system was generally good, with excellent speeds and accuracy. It just needed adjustments for fine-tuning in extreme lighting and different meter type scenarios; and indeed, it was determined to work well and consistently after tweaking.

4.6 Conclusion:

This chapter presented the experimental setup and detailed the process of integrating the extracted meter readings into the ThingSpeak IoT platform using Simulink. The Simulink model was designed to collect the processed readings from the MATLAB workspace, convert them into a suitable format, and upload them to the cloud in real-time. The configuration of the ThingSpeak channel ensured proper storage and visualization of data, enabling remote energy monitoring. Through this integration, the system demonstrated seamless data transfer from image processing outputs to cloud-based storage, establishing a complete and automated workflow for energy consumption tracking.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Results:

The automated energy meter reading system was tested using multiple images of conventional energy meters captured under varied lighting and environmental conditions. The system underwent each processing phase—from image enhancement in MATLAB, to digit extraction using OCR, and finally real-time upload to the ThingSpeak IoT cloud platform via Simulink.

The following observations were made during testing:

- The OCR module in MATLAB extracted numerical meter readings accurately in 95–97% of cases compared to manually noted values.
- The average time delay for transmission from the MATLAB workspace to ThingSpeak was observed to be approximately 5 to 8 seconds, which is acceptable for near real-time monitoring.
- The readings were successfully plotted and stored on the ThingSpeak dashboard using the configured channel (Channel ID: 2924753), as shown earlier in *Figure 4.4*.
- The system was evaluated under different lighting scenarios, meter types (digital and analog), and slight angle tilts in image capture. It maintained stability and output consistency, though with minor variations in OCR confidence.

These outcomes validated the robustness of the preprocessing steps applied (grayscale conversion, adaptive histogram equalization, noise filtering, and binarization), which were previously illustrated in *Figures 3.4 to 3.7*.

5.2 Discussion:

The project successfully demonstrates that conventional energy meters can be automated using image processing without the need for hardware changes or additional modules like ESP. By leveraging existing meters, the system presents a low-cost, scalable, and environmentally sustainable solution for remote energy monitoring.

The preprocessing steps significantly improved the clarity of meter digits, thereby increasing the OCR recognition rate. Adaptive histogram equalization proved effective in enhancing images captured under dim lighting. The integration with ThingSpeak allowed for seamless real-time monitoring and historical data analysis, fulfilling the objective of making energy data accessible remotely.

However, some challenges were noted during testing:

- Glare or reflections on meter screens sometimes reduced OCR accuracy.
- Images captured at steep angles caused minor distortion, requiring careful alignment.
- Old meters with faded or scratched displays slightly affected the reading clarity.

Despite these challenges, the overall system maintained high accuracy and reliability, proving suitable for practical deployment in both domestic and commercial settings.

The project results suggest that, with minor enhancements like glare reduction filters or perspective correction algorithms, the system can be further improved to achieve near-perfect automation in real-world conditions.

CHAPTER 6

CONCLUSION

The developed automated energy meter reading system demonstrates an efficient and reliable approach to capturing energy consumption data without the need for physical modifications to existing infrastructure. By using image processing and OCR techniques in MATLAB, the system effectively reads meter values from conventional displays under various real-world conditions, including uneven lighting and different meter designs. The integration of the extracted readings with the ThingSpeak IoT platform enables real-time cloud monitoring and storage, creating a practical and scalable energy tracking solution.

This approach eliminates the need for additional hardware like ESP modules or smart meters, reducing both cost and electronic waste, and promoting sustainable technology adoption. The system also addresses common issues in manual meter reading such as human error, data delays, and inconsistent reporting, making it suitable for a wide range of domestic and commercial applications.

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CONCLUSION

This project successfully demonstrates the integration of MATLAB image processing techniques with cloud-based IoT platforms for real-time energy monitoring. The use of advanced image processing algorithms allowed for the accurate extraction of energy meter readings from images, eliminating the need for manual data entry. By integrating ThingSpeak with Simulink, the system enables seamless data transmission to the cloud, providing continuous visualization, analysis, and logging of energy consumption.

This solution offers a cost-effective and scalable approach to digitize traditional energy meters, with potential applications in smart grid technology and energy auditing systems. Overall, the project showcases the feasibility of using IoT and image processing for energy management, providing an efficient and automated system for real-time energy monitoring.

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CONCLUSION

With the automated energy meter reading system able to ascertain energy consumption with an efficient and accurate measure, those factors like non-uniform lighting conditions or the wide variety of meter types would not constitute a liability for the system. Thus, combining it with cloud storage while controlling real-time monitoring via ThingSpeak to create a full-blown functioning energy utilization in terms of practicality and scalability.

The system can be put into action in several applications in the domestic and commercial fields as a remote energy monitoring device. It reduces the human error factor to an extent in terms of manual readings by providing clients with timely information for them to utilize maximum possible efficiency from their electricity. The project gives the first indications that it could work as an integrated arm of the smart energy management system, which helps further sustain development and resource management.

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REFERENCES

1) Maheshwari U., Singh K. (2023). Automatic Meter Detection and Recognition. IJRASET.

2) Priya B.L., Dhenakaran S.S. (2018). New Approach for Text-Based Image Compression. IJSRST.

3) Manisha V. Shinde, Pradip W. Kulkarni (2014). Reading of Energy based on Image Processing Technology. Technovision-2014