Analog to Digital Meter Reader Converter Using Signal Processing Technique

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Abstract— The need for the Internet of Things to link devices and equipment, mostly in industry, is compelling industrial players to ensure they are adequately equipped with such technology. For newly established industries, it is prudent to begin by equipping their facilities with IoT-enabled technology that is widely accessible on the market. However, for older businesses, building and machine, the changeover process may be expensive, requiring them to replace existing equipment with new IOT-ready technology. A way to do this is to enhance the existing equipment without having to replace it. We suggested a solution in this article to an issue with analogue meters. The analogue reading is converted to digital using an image processing method. Thus, the digital readings can be sent to an IOT platform, allowing for effective asset monitoring.

Keywords—*Image Processing, Analog to Digital meter converter, Internet of Thing*

I. Introduction

Nowadays, asset monitoring may be accomplished efficiently as a result of IOT technology, which is increasingly changing the way businesses operate, particularly in the industrial sector. A machine equipped with an IOT-enabled infrastructure can significantly improve industry operations by decreasing personnel and breakdowns[1]. To work with the IoT infrastructure, the data generated by the equipment must be in digital form.

Due to the fact that the shift to the IOT age is still relatively new, numerous industries are not yet prepared. According to [2], many firms in Japan continue to monitor and regulate the manufacturing environment using analogue meter. Analogue meter require human interaction in order to record and process data. The method is prone to human error, and complications could occur if it were conducted in a remote location.

The solution is to replace the existing equipment with an IoT-enabled digital meter. However, the issue is one of replacement cost. Some existing industrial meter are still reliable, but require human intervention to read the data. Another possibility is to simply replace the analogue meter with a digital one. However, not all machines or equipment may be modified in this manner. For instance, in this project, when it comes to hospital equipment, no modifications to the existing machine are permitted. Such issues require a more hygienic solution.

Numerous researchers have set their sights on digitalizing analogue meter. One approach that appears promising is to tackle the problem using Deep Learning Artificial Intelligence techniques [2, 3]. Using a camera-captured image of an analogue meter, the image is trained using AI techniques such as Convolution Neural Networks (CNN), You Only Look Once (YOLO), and Single Shot Detectors (SSD) with a recorded accuracy of up to 95%. The usage of AI has the advantage of requiring significantly more processing power than simple image processing techniques such as segmentation and tagging.

In this research, we attempt to solve the problem through image processing techniques rather than through the use of artificial intelligence elements that require additional processing CPU resources. Due to the fact that the meter used for this purpose is located at a government hospital in Malaysia, Hospital Tuanku Fauziah Kangar, any change to the machine or meter is not permitted. A vacuum insulated evaporator (VIE) tank is utilised to house the meter. The meter is used to monitor and control the liquids' levels and remaining volume. Level meter are used to detect and quantify liquids in tanks. During the maintenance time, maintenance personnel are responsible for physically reading the meter at each facility. As a result, this monitoring procedure should be automated to eliminate human error.

The purpose of this project is to build an image processing technique for converting analogue meter readings to digital values and transmitting them to an IoT platform dashboard.

II. Related Work

Toshiyuki Sakai and his group were among the first to develop image signal conversion for metre reading in 1982[4]. Since then, additional work has been done to digitalize the analogue metre.

In the work of Jakob S. Lauridsen and his colleagues, a recorded video of a pressurised gas was analysed using a computer vision technique [5]. A bilateral filter and an adaptive threshold were employed to enhance the sharpness of the scanned image. This technology eliminated sounds associated with pressure gauges. The gauge meter's reading was determined by the pointer angle and scale marks. These were proposed based on five characteristics: rotated bounding box ratio, mass, compactness, distance to gauge centre, and orientation inaccuracy.

In other work, Robert Sablatnig and Walter G. Kropatsch stated that the value of the meter might be determined by detecting their scales and pointers' positions in an intensity image[6]. The work is centred around three primitive elements: pointers, scales, and lettering elements. Although the final result of this paper depicts the conversion of an analogue meter, numerous methods were used to determine the positions of each element on the meter.