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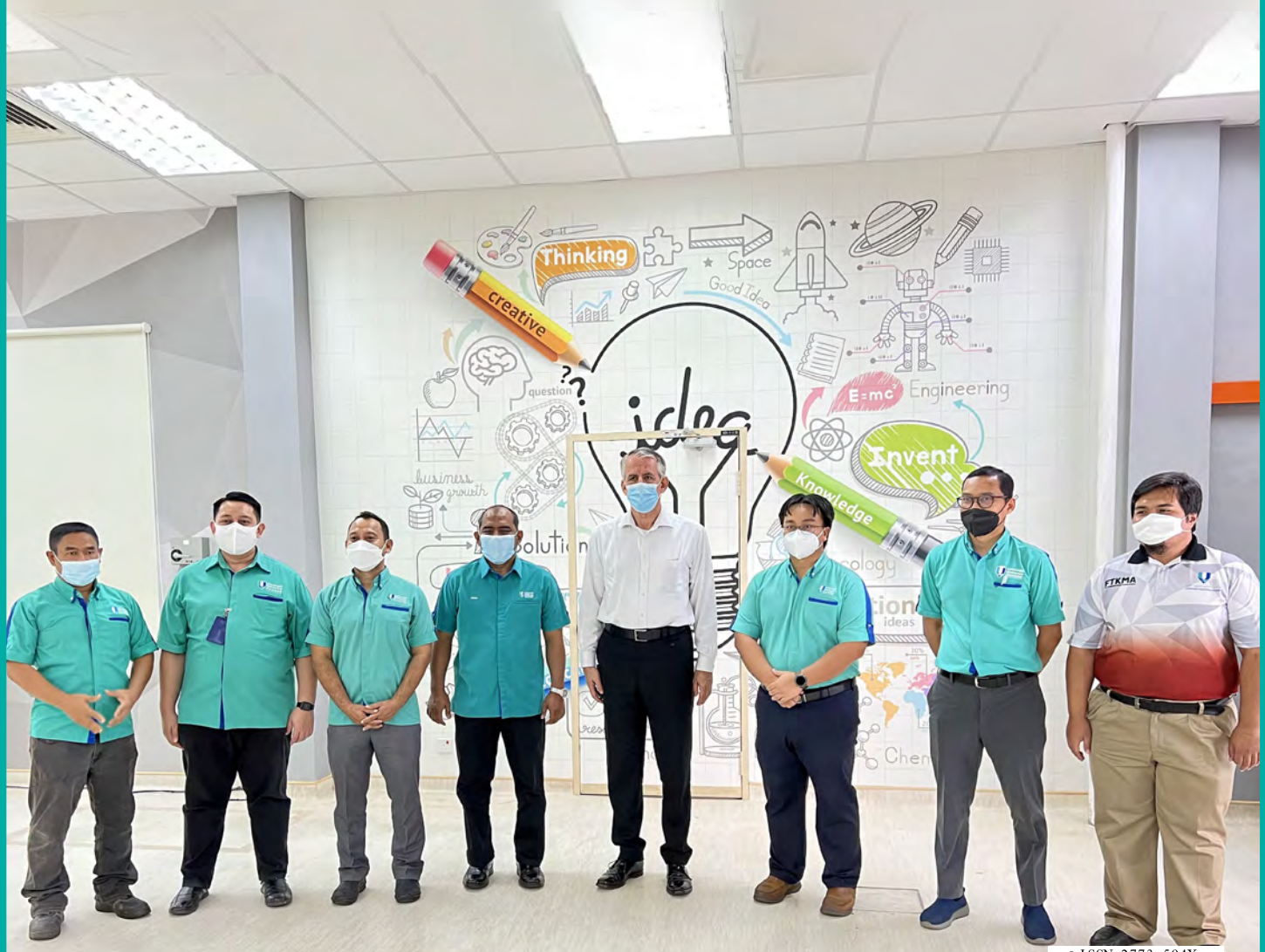

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Fiber Bragg Grating Gap Sensor as An Innovative Idea for Critical Flange Monitoring

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Figure 1. Effect of the gap in bolted flange failure

Bolted joint integrity is a critical parameter to preserve for safe and efficient operation of the pipeline system, mainly in the flange gap monitoring exercise. Failure to precisely monitor any early signs of components gaping may result in a sudden failure or even injuries to personnel (Figure 1). Conventional monitoring method is primarily attained by embedding an electrical strain gauge sensor into the body of the bolt, to make it a "smart bolt". The two major drawbacks of the sensor are the need for an extensive cabling network which in return, yields a significant signal power loss over the long-range data transmission. In addition, a strain gauge-based sensor can only perform a monitoring job for mere several metres before the transmitted electrical signal get attenuated severely, compromising the diagnostics accuracy and reliability.

On the other hand, the proposed method in utilising the fibre Bragg grating (FBG) sensor comes with an impressive capability to perform the long-range monitoring (e.g. 1000 m) without experiencing significant loss in signal transmission. Unlike conventional strain gauges, FBG will not cause electrical spark that may potentially lead to an explosion, making it a credible candidate for the application in harsh environments or underwater. In addition, FBG sensor features high data accuracy and resolution as well as being highly immune to disturbances from electrical spark and electromagnetic interference (EMI). Furthermore, FBG materials are also capable of withstanding temperatures of up to 600°C without having its reliability compromised or physically degraded.

The innovative gap sensor (Figure 2) is completely passive and offers inherently insensitivity to the effects from environmental induced drift. This detachable gap sensor renders the design to be commercially appealing for a non-destructive gaping evaluation. Equipped with a solid and metallic protective cover, it makes the FBG the ideal choice for installation in any harsh working environments. The FBG technique is now filed for product patent under a title "A Gap Monitoring Device for Two Connected Flanges" with application number PI2021007060. The invention is awarded with a Gold Medal award (Figure 2) in the 2021's International Invention, Innovation & Technology Exhibition (ITEX).

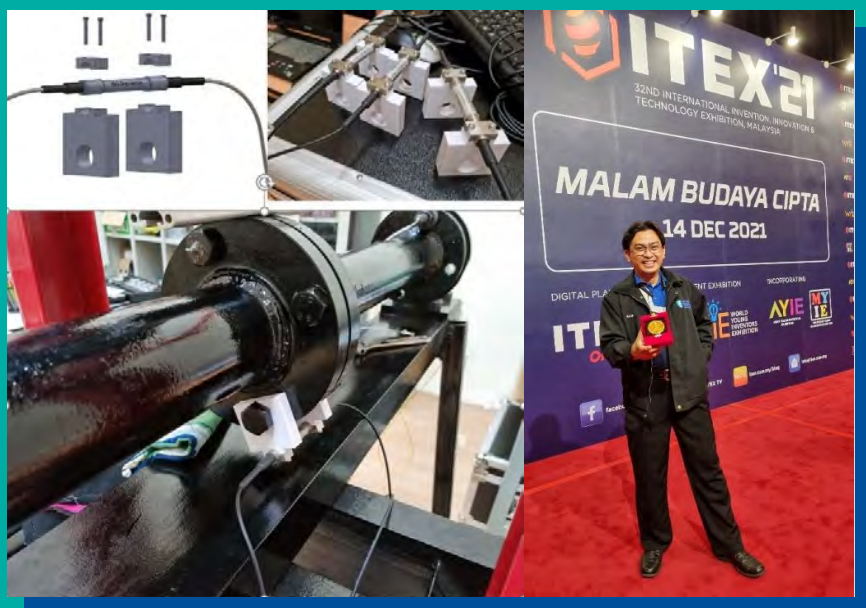

Figure 2. Product image & Gold Medal in ITEX2021