CHAPTER 7

FLOOD MONITORING SYSTEM USING OPTICAL FIBRE SENSOR WITH IoT

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7.1 INTRODUCTION

One of the most dangerous disasters in Malaysia is flooding, which occurs almost every year, especially during the monsoon season from October to March. The latest serious hit happened during the last December 2021 till early 2022. According to media reports, the death toll increased to 46 people, and Malaysians suffered an estimated RM 6.5 billion in property damages (Faber Consulting AG, 2021). The Malaysian National Disaster Command Centre (NDCC) stated that 37,670 people were displaced in 388 evacuation centres across eight states in Malaysia (Reliefweb, 2022). There is no doubt that flood disasters are among the most common and severe natural disasters that cause severe destruction.

A flood is water that rises and overflows on land that is usually dry and not covered by water (Department of Irrigation and Drainage Malaysia, 2017). Numerous factors can play a role in the occurrence of this disaster, including heavy rains, ocean waves that come ashore and broken dams (The National Severe Storms Laboratory, 2021). The flash

flood is the deadliest (Schwab et al., 2021). This is due to the devastating force of floods combined with the unpredictable increase in water level. Flash floods usually occur in low-lying or flat places that can be drowned fast before moving to higher land, especially with abundant rainfall. Aside from natural causes, flash floods occur due to human activity, such as agriculture and deforestation, the construction of structures and infrastructure in flood-prone locations, and the construction of bridges that can restrict the flow of water and mitigate climate change due to greenhouse gas emissions.

7.2 FLOOD MONITORING SYSTEM

The advancement of optical fibre sensors has reached a stage where the impact of this type of sensor is visible to others. Fibre sensors have several advantages over other technologies, including being relatively small and lightweight, having high survivability in extreme conditions, having no electrical signal at the sensor head, having immunity to electromagnetic interference, having a remote distance between signal generation and detection, and the possibility of an analogue signal generation. Consequently, optical fibre sensors are perfect for sensing liquid levels in harsh situations since they do not need electrical impulses.

On the other hand, The Internet of Things (IoT) refers to the interconnection of the physical device linked to other items, such as smart devices. The nodes send information to an online server through the internet. Users can operate and remotely monitor the nodes using existing network architecture and various mobile devices, such as smartphones (Brown, 2016). This IoT can be integrated with any sensor including optical fibre sensors.

7.2.1 Related Works

Flood detection systems are critical for preventing building damage and, most importantly, loss of life. The system operates by detecting or measuring the water level using different ways detected by sensors and

then transmitting the data to the server or controller over wireless or wired networks. The captured information may then be monitored for future action by the users.

A remote flood monitoring system can be done by establishing a wireless mote network and Plastic Optical Fibre (POF) sensors were used to create a remote flood monitoring system (Munawar et al., 2022). The wireless remote, made up of a network of MICA2DOTTM units, served as a platform for monitoring and recording the signal from the POF sensors and wirelessly transmitting the data to a base station. The integrated wireless POF sensor unit has been constructed as a prototype, enabling the autonomous unit to be deployed remotely at as many monitoring stations as required. Four wireless optical fibre mote sensors were used to detect increasing water levels in a basin during a flood monitoring simulation. The successful integration of the wireless platform with a POF-based liquid level sensor and subsequent presentation of the system prototype for flood monitoring applications is a novel study component.

As the sensor probe comes into contact with the liquid, the sensor employs a well-known sensing technique based on the Fresnel reflection of the optical signal. The drawback of this approach is that it must first improve the signal intensity loss ratio by modifying the tip of the U-shaped POF as shown in Figure 7.1. Wireless communication through MICA2DOT devices is not user-friendly since it requires knowledge of the MoteView programme, which monitors flood conditions.

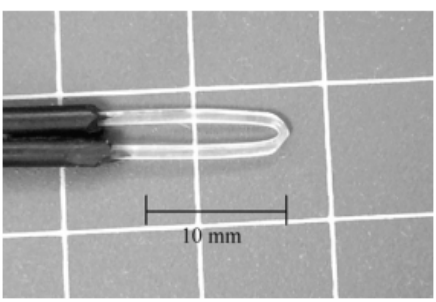

Figure 7.1 The modified U-shaped POF used in the project (Kuang et al., 2008)