

Research Article

IRFAN – Irrigation of water automatically on natural flood

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Abstract: Malaysia has been annually affected by floods during the monsoon season as well as in some cities have flash floods. The floods have caused mass evacuations, deaths, and loss of properties. Malaysia has developed several initiatives to overcome the floods such as the SMART tunnel project and flood monitoring system. However, the initiatives offered are only countering the flood at major places and do not consider a solution for the stagnant flood. In this paper, irrigation of water automatically on natural flood (IRFAN) is proposed as a solution to lower the chances of stagnant flood as well as preventive tools for the upcoming flood. IRFAN is a water diversion technique that can redirect the flow of the water flood through purpose-built channels. This technique can reduce the excess water peak flows and lowers the chances of flood. With the integration of Artificial Intelligence, the water flood can be automatically diverted towards other streams based on the level of water. The system is also embedded with an alarm system to avoid thieves from stealing the main component. The development of this system can help governments and society on reducing mass evacuations, deaths, and loss of properties.

Keywords: stagnant floodwater; flood; water diversion technique.



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1. INTRODUCTION

Flood is one of the natural phenomena in Malaysia that is annually occurred during the monsoon season between October and March. The floods have caused tremendous worst effects either to the government or society. The National Flood Forecasting and Warning Program mentioned that in 2014, the flood recorded 25 total deaths, 500,000 people evacuated and the loss of destruction cost exceeded RM2.85 billion (Department of Irrigation and Drainage Malaysia, 2019). Due to this reason, Malaysia has initiated several programs on reducing the effects of the flood such as the SMART tunnel project and flood monitoring system. These systems, however, are only available in major places, i.e., Kuala Lumpur but not covering nearby rivers or sea locations as high-risk areas to be flooded, as shown in Figure 1 (GlobalFloodMap.org, 2023).

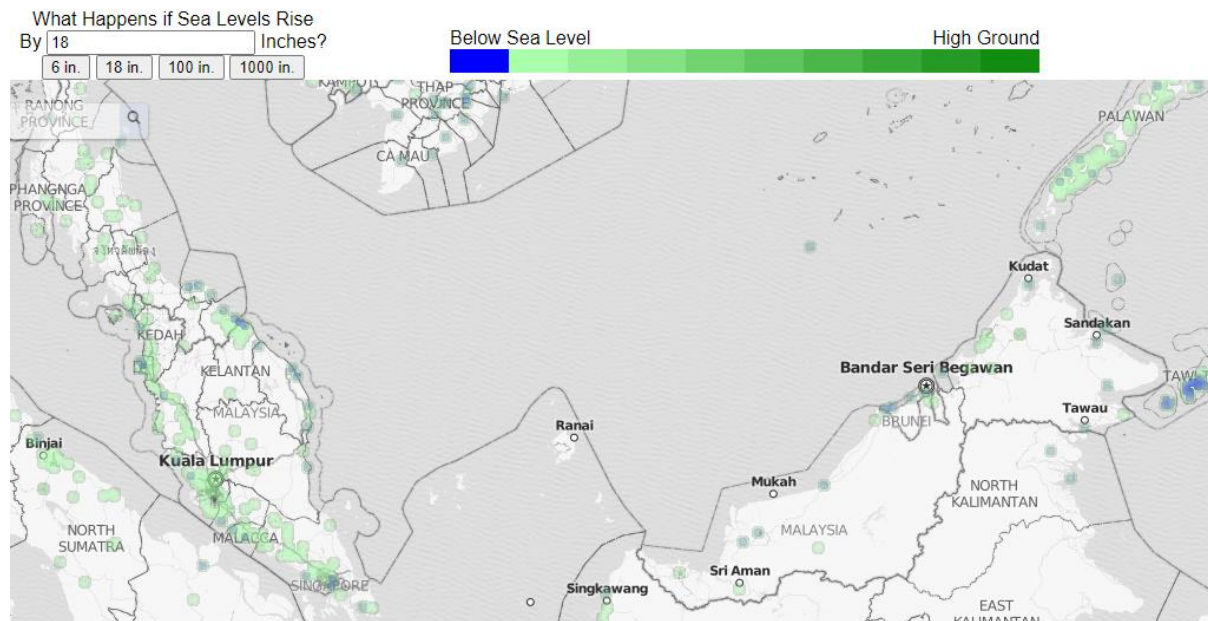


Figure 1. High-risk flood areas in Malaysia (GlobalFloodMap.org, 2023)

Johor, which is located in the southern state neighbouring Singapore, is the recent worst affected area and has caused 50,000 people evacuated from their homes (Aljazeera, 2023). Stagnant floodwaters in Johor have hindered plans for victims to return to their respective homes. The stagnant floodwaters have a negative effect as the flood water has taken longer than usual to recede. State Drainage and Irrigation Department and Public Works Department mentioned that there are two ways to get rid or reduce of the stagnant floodwater which are pumping out of the water and digging drainage channels to flow into the river.

Artificial Intelligence (AI) is progressively developing and implementing in many places such as industries and residential across the globe to act as a simulation of human intelligence processes by machines through computer systems (Ed Burns, 2023). Assessment of flood using AI has been extensively studied. Chapi et al. (2017) introduced mapping flood susceptibility using Bagging-LMT as a new AI model. Saravi et al. (2019) then proposed the use of AI to improve preparedness and resilience against adverse flood events. A recent study has been developed by Zabihi et al. (2023) which combines AI and multi-criteria decision-making computations for flood damage management in a smart sustainable system. The studies showed application of the AI in assessing and preventing floods from mass destructions such as deaths and destroying properties.

Irrigation of water automatically on natural floods (IRFAN) has been proposed as an additional solution to reduce the effect of flood water. IRFAN is a system that uses a water diversion technique which redirects the flow of the water flood through purpose-built channels. This technique can reduce the excess water peak flows and lowers the chances of flood. Arduino UNO is act as an AI that is embedded in the system to channel the water by pumping it out into other places automatically as well as reducing the tendency of stealing the main component through the addition of the alarm system. The development of this system can assist governments and society in reducing the negative effects of the flood such as mass evacuations, deaths, and loss of properties.

2. METHODOLOGY

IRFAN has been developed by using Arduino UNO as an AI that can automatically redirect the water flows based on the high level of water from the stagnant floodwaters. The Blynk IOT is used

as a configuration and monitoring app for the system to function. Development of the IRFAN system requires five main components as a detection system which are a moisture sensor, PIR motion sensor, level sensor switch, temperature and humidity sensor, and lamp. Table 1 presents the main components with functions. Figure 2 shows the summary of the overall methodology. Based on the figure, there are two separate steps in developing the IRFAN system, namely, i) functionality of the water pump, and ii) avoiding intruders.

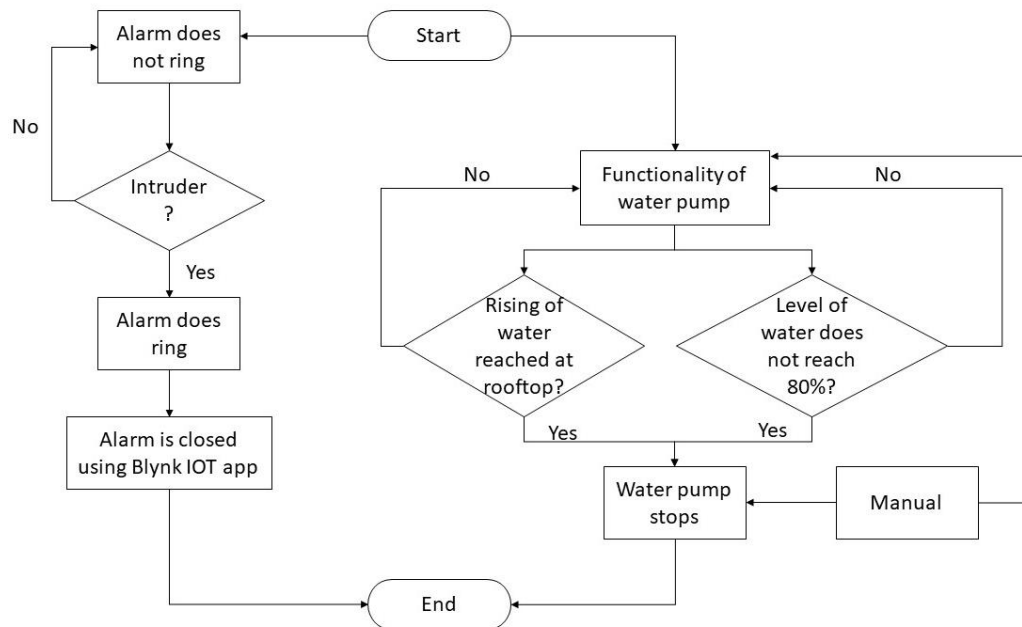


Figure 2. Summary of the overall methodology

Table 1. Main components with functions

Main components	Function	In the IRFAN system
Moisture sensor	Measure the amount of water	Use to cut off all of the electricity to avoid electric shock
PIR motion sensor	Sense and detect motion	Use to detect motion to avoid stealing the main components
Level sensor switch	Determine the level of the liquid	Detect the level of water floods
Temperature and humidity sensor	Detect temperature and humidity	Detect the temperature and humidity of the environment
Lamp	Light on the surrounding	Act as a warning for the people to beware of the water flood level

2.1 Functionality of water pump

The water pump can be automatically closed or opened based on two conditions. The first condition for the system to have functioned is when the level of water does reach 80% from the level sensor switch and the second condition is when the level of water didn't reach the rooftop. The water pump is automatically closed once one of the two conditions mentioned is breached. The functionality of the water pump can also be operated through manual conditions by switching the operation in the Blynk IOT app. The moisture sensor is embedded in the system as a switch to cut off all of the electricity to avoid electric shock. To determine the level of water, a level sensor switch is used. The lamp is implemented as a detector to let people know the level of water is rising and reached 80% from the level sensor switch. Temperature and humidity sensors are added as well to ensure early preparation

through the temperature and humidity of the surrounding. Yatim et al. (2013) conducted a study on the impact of climate change on flood risk in the Muar River Basin. The study found that temperature and humidity are several important factors to understand climate change in extreme weather.

2.2 Avoiding intruder

Due to the high price of the water pump, it tends to be stolen by thieves. Hence, the alarm system is included in the IRFAN system to let people know when the intruder nears the water pump as the important component. The alarm can be switched off using Blynk IoT app. PIR motion sensor is implemented in the system to ensure the components safely.

3. FINDINGS

The development of the IRFAN system is useful to reduce the mass destruction made by natural floods, especially the stagnant floodwaters by redirecting the water to other streams such as rivers or placing it in a reserved rainwater catchment. Through this technique, the time to recede can be reduced for the stagnant waterfloods and less property is destroyed as well as giving more time for the evacuation process. The development of this system can also be able for people to be alert to the rising water levels and can make early preparation on saving lives and valuable items. The rate of the water flowing out from the place that is affected by the flood are depending on the types of water pumps and sizing of the piping. A higher capacity of the water pump can speed up the water flowing out process and a bigger diameter size of the piping can deliver more water towards other places.

5. CONCLUSION

The proposed IRFAN system could reduce the tendency of mass destruction due to natural floods, especially in stagnant waterfloods. The water diversion technique can help to reduce the time for stagnant floods to recede as well as give more time for the people to evaluate while the water level is rising. The effectiveness of the IRFAN system still has a long way to be identified due to the system not being utilised in real situations. However, the IRFAN system is expected to increase the safety and resilience of the place as well as the ability to reduce the mass destruction due to flooding.

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