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Artificial Intelligence based Subway Rainwater Status Notifier and Disposal System

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Abstract: In this paper, developed a system to detect the level of water in a subway system and predict the hazardous zone and also inform the people to go to another safer zone**.** Submerge is one of the most destructive natural events that severely damage the ground and inundate underground infrastructure. Underground subway systems inmetropolitan areas are susceptible to flooding, which may be exacerbated when land subsidence occurs. However, previous studies have focused on flood risk evaluation on regional/watershed-scales and land subsidence monitoring in plains, instead of on subway flood risk evaluation and how land subsidence aggravates the flood risk in subway systems. Using theproposed risk indicators and field survey data, present a method assessing the flood risk of metropolitan subwaysystems under a subsidence condition based on the artificial intelligence combined with arduino nano and GSM. The proposed method was used to evaluate the flood risk of the metropolitan subway systems and apprise the people to go secure zones.

Keywords: flood risk; metropolitan subway systems; land subsidence; GSM module method.

I. INTRODUCTION

Flooding is one of the most devastating natural disasters that can cause tremendous loss of life and economic damages. According to a preliminary investigation, floods resulted in approximately 7 million deaths and more than USD 700 billion losses worldwide from 1900 to 2016. Flood risks will increase in the future due to global and regional climate changes which cause extreme hydrological events, land subsidence, land-use change, and increasing sediment supply to water bodies. These issues pose serious challenges to the sustainable development of human society. Recently, rapid urban development has led to the extensive construction of underground infrastructure in large cities. As a key piece of subsurface engineering, the subway system has become a significant underground lifeline, which plays a vital role in alleviating urban traffic congestion. However, subway systems exacerbate urban vulnerability to natural hazards (e.g., rainstorms, flooding,) in addition to providing convenience. In India, many major cities have frequently suffered from urban flooding. Besides triggering serious urban waterlogging on the surface, rainstorms and flooding events also severely inundate underground facilities, especially the subway systems of large cities. Thus, it is necessary to incorporate the subway system‟s flood risk evaluation and prevention into the current urban management.

II. BLOCK DIAGRAM

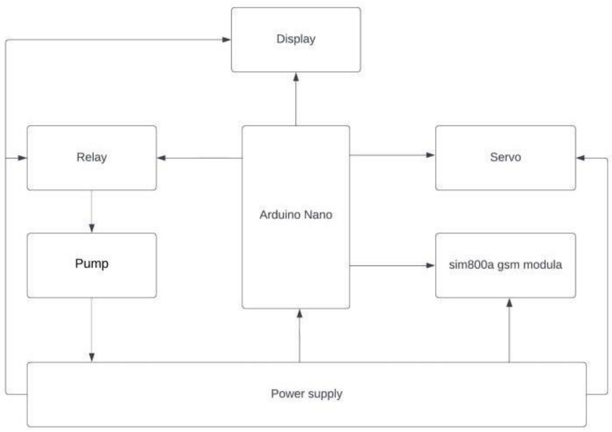

Fig 1 ARTIFICIAL INTELLIGENCE BASED SUBWAY RAINWATER STATUS NOTIFIER AND DISPOSAL SYSTEM

III. LITERATURE SURVEY

In our study, subway systems flood risk is indirectly reflected using the regional flood risk level within a 500 m radius of subway lines. Thus, the selection of regional risk indicators is critical to risk results. Previous flood risk evaluations at the regional and watershed scales commonly omit key factors (e.g., subway line density, passenger flow) that affect subway flooding. For example, in the flood risk evaluation of the Beijing-Tianjin-Hubei region, Wang et al. mainly considered natural and socio-economic indicators such as precipitation, rivers, topography, geomorphology, population, and gross domestic product. Consequently, the above risk indicator system cannot effectively depict the flood risk of the subway system. Considering that the inundation in the subway system primarily results from extreme rainfall events, previous studies have shown that the Beijing subway system experienced segmental and uneven subsidence during 2003–2018. In addition, the mean groundwater depth in the Beijing Plain rose by 3 m (2015– 2019) since the Middle Route of the SNWDP (the South-to-North Water Diversion Project) started to operate. The continuous rise of groundwater level combined with uneven land subsidence can increase the subway systems flood risk. Thus, cumulative land subsidence and groundwater depth were included in the hazard indicators. The direct cause of flooding in the subway system is the ingress of surface floodwaters; that is, more station exits indicate a higher exposure level of the subway system to flooding. Of course, whether flooding enters the subway system is dominated by the station‟s elevation and slope except for rainfall. Rivers act as confluence channels during flooding. Their overflow often leads to the inundation of adjacent subway lines and stations . Moreover, the fault activity deformed the 3 subway system and caused tunnel collapse and water leakage. The land covers affect the confluence and infiltration rate of urban surface water flooding. The rapid growth of impervious surfaces increases the urban flood risk. Therefore, we incorporated these factors into the exposure indicator system Areas with high population and GDP densities tend to have well-developed when flooding occurs. Floodwater entering a subway station may flow along the subway tunnel and affect adjacent lines. As a result, extreme flooding may cause a more significant loss in areas with high line densities . Moreover, the road network acts as a temporary drainage channel when surface flooding exceeds the underground drainage systems capacity during heavy rainfall. However, station exits are distributed on roadsides or in the middle of the main road, which increases the risk of surface flooding entering the subway system. 2. There are four main entries for the subway system: entrances/exits (elevators and stairs for both personnel and commuters), emergency exits, ventilation grates, and tunnel entries . In particular, station exits are the main channel for surface flooding into the subway system because of their numerous and widespread distribution. Hence, priority flood prevention measures must effectively prevent flood intrusion into subway stations. Based on field investigations, the height of some Beijing subway stations‟ exit steps is reduced by the increased height of the road surface, which raises the possibility of surface flooding entering the stations during heavy rainfall. We suggest elevating the height of the exit (entrance) to prevent flooding into subway stations and tunnels, especially for low-lying stations Flood prevention measures for subway stations. (a)Auto barricade (b) Floodwater harvesting system and pumping stations. The municipal drainage pipe network operates at full capacity or is overloaded during heavy rainfall. Floodwater harvesting systems and pumping stations should be installed in subway stations to ensure that entered floodwater can be quickly discharged.

IV. METHODOLOGY

This project is mainly focused to detect the excess water staged under the bridges blocking the road ways. We detect those that flood and evacuate that water with automated pumps. In this project the Arduino nano is used as the microcontroller and the water sensor is used to detect the water level. When the water level gets increased then the microcontroller activates a automated pump with the use of relay, then the alert system closes the way using servo motor adjusting the position of the barrier to block the road indicating the caution to the passengers and displays the current status and activate the passengers to go another routes with help of GSM module. Once the water is evacuated from that place then everything is made normal automatically.

V. WORKING

Over the last few years, number of researches is conducted on subway rainwater disposal and notifier systems. Our system consists of certain main units which coordinates with each other and makes sure that ambulance reaches the subway system in metropolitan areas without any delay. This system divided in the following units such as ArduinoNano, Bluetooth, and servomotor water sensor/water level sensor and water pumps. This project is mainly focused to detect the excess water staged under the bridges blocking the road ways. We detect those that flood and evacuate that water with automated pumps. In this project the Arduino Nano is used as the microcontroller and the water sensor is used to detect the water level. When the water level gets increased then the microcontroller activates a automated pump with the use of relay, then the alert system closes the way using servo motor adjusting the position of the barrier to block the road indicating the caution to the passengers and displays them the alternate route. Once the water is evacuated from that place then everything is made normal automatically. • To instantly rescue the accident victims by connecting a system with Arduino Nano linked with a Bluetooth module. • Designing and implementing the notification mechanism for Manual and Automatic system.

VI. TESTS AND RESULTS

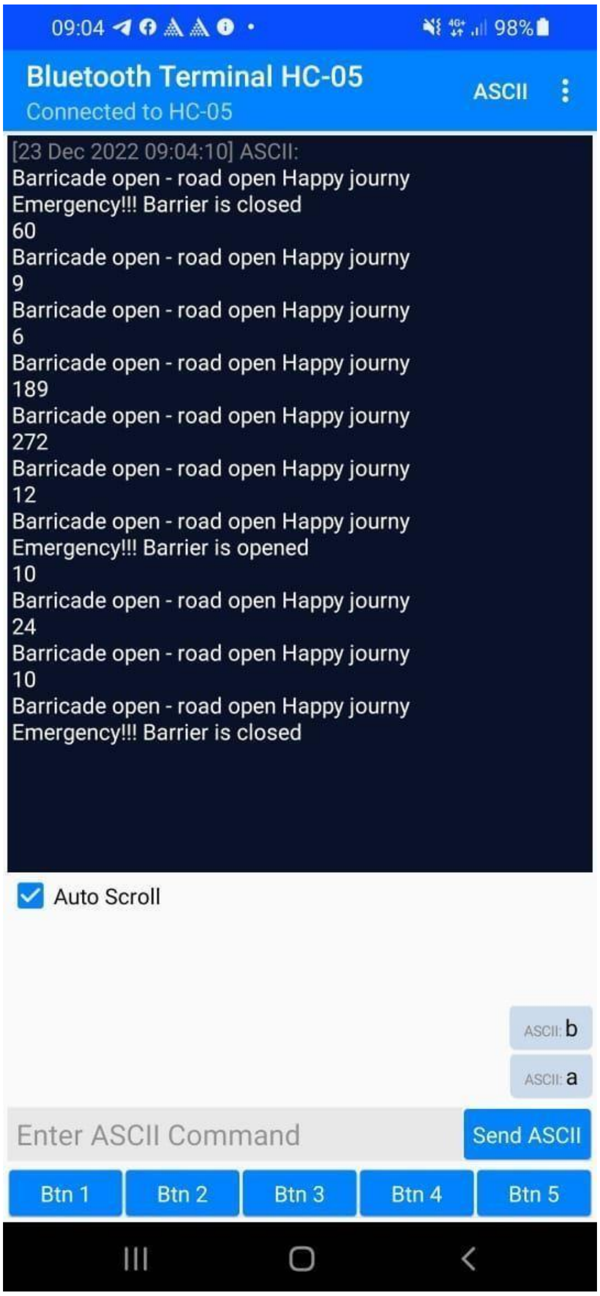

Fig 2 Project Model (a)

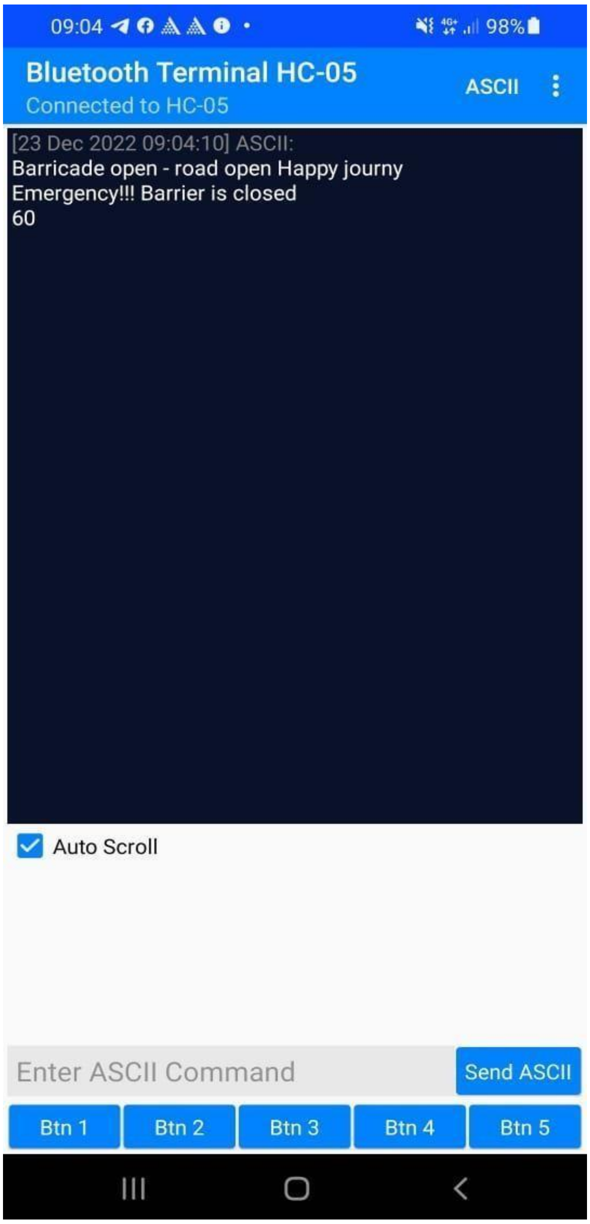

Fig 3 Project Model(b)

VII. CONCLUSIONS

This system determined the risk factors for preventing flood and draining water logging in the urban subways through methods, including investigations, consultations, discussions, negotiation and reference to the other literatures. In addition the list of influence factors for risk evaluation of the urban subway was formed. These can be applied to more subway constructions and we need to make appropriate adjustments according to the difference of each subway. We try to provide new risk evolution for security experts, architectures, design engineer, construction risk management engineer, governments or other relevant persons, for the constraints, this method cannot be verified comprehensively through more actual projects. Next further research will be carried out through the whole life cycle of subway project, not just the construction and operation periods. We hope this model is widely and practicably applied, and we can achieve further research results and provide more reference for more risk assessment participants.

VIII. FUTURE ENHANCEMENTS

The project has vast scope in developing the system and making it more user friendly and the additional features of the system like:

- By installing this system to quantifying the effectiveness of rainwater harvesting in reducing the flood volume and consequently, mitigating urban waterlogging problems in a residential area in the cities.
- Avoid tunnel planning in the initial stage and protect entrances to subways.

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