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Underground Emergency Communication System for Hilly and Forest Regions

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Abstract-- Recent years, from the majority of field experiences, it has been learned that communications networks are one of the major pillars for disaster management. In this regard, the exploitation of different space technology applications to support the communications services in disasters plays an important role, in the prevention and mitigation of the natural disasters effects on terrestrial communications infrastructures. However, this chapter presents the design and implementation of an emergency communications network for disaster management, based on a topology that integrates communications satellites with remote sensing satellites into an emergency communications network to be activated in disaster events, which affect public or private terrestrial communications infrastructures. Likewise, to design the network, different technical and operational specifications are considered; among which are: the emergency operational strategies implementation to maneuver remote sensing satellites on orbit for optimal images capture and processing, as well as the payload and radio frequencies characterization in communications satellites to implement communications technology tools useful for disaster management. Therefore, this emergency communications network allows putting in operation diverse communications infrastructures for data and images exchange, making available the essential information to accomplish a fast response in disasters or to facilitate the communications infrastructures recuperation in emergencies situations.

I. INTRODUCTION

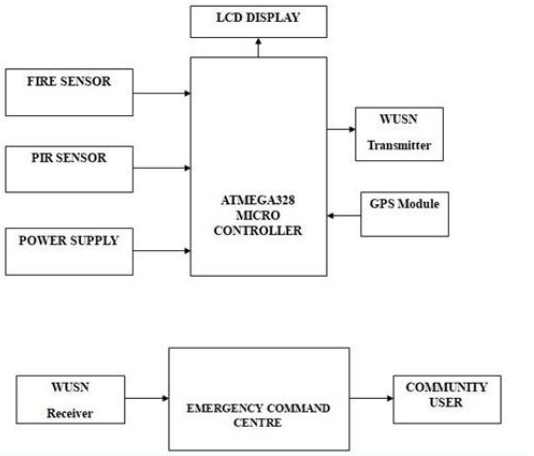
At the present time around the world, the use and integration of different space technology applications that contribute to planning and designing alternative communications networks for the relief of the disaster's impact, on the terrestrial communications infrastructures, have gained great importance in the disaster management scenario. In each one of the disaster stages, the information flow between the disaster management organizations, the population, and other actors, in general, is a critical and fundamental factor to provide a quick and opportune response to all aspects linked to a disaster event. Frequently in diverse disasters situations, the terrestrial communications infrastructures are affected by the disaster impacts, phenomena that cause the communications services unavailable to support in the disaster management. In most cases, the disasters impact mainly communications services, such as the mobile phone networks, fiber optic systems, terrestrial microwave systems, fixed telephone services, private and public TV networks, commercial radio networks, and also the Internet services infrastructures. Scenarios that have a considerable impact in all processes are related to the preparedness, response, and recovery in disaster conditions, since the communications services have an important function in the disaster management tasks.

II. LITERATURE SURVEY

Clearly define the scope of your literature survey, specifying the focus areas such as communication technologies, underground infrastructure, emergency management in rugged terrains, etc. Use academic databases, online journals, conference proceedings, and institutional repositories to search for peer-reviewed articles, conference papers, reports, and dissertations related to underground communication systems, emergency communication, and geographical including terms like "underground communication," "emergency communication systems," "rugged terrain communication," "forest region communication," and variations thereof. Systematically review the literature, focusing on studies, projects, and case studies that discuss communication infrastructure in challenging terrains, emergency response strategies, technological advancements, and best practices for underground

installations. Analyze the findings from the literature, summarizing key insights, technological trends, challenges, and solutions proposed by researchers and practitioners in the field. Identify gaps in the existing literature where further research is needed, and opportunities for innovation or improvement in underground emergency communication systems for hilly and forest regions. Critically evaluate the reliability, validity, and relevance of the sources, considering factors such as the credibility of the authors, the rigor of the research methodology, and the currency of the information.

III. PROPOSED SOLUTION



Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. A flame detector is a type of sensor that can detect and respond to the presence of a flame. PIR sensors are commonly utilized in security alarms and automatic lighting applications. Navigation - getting from one location to another. Tracking - monitoring object or personal movement. Mapping creating maps of the world. Timing bringing precise timing to the world.16×2 LCD display commonly used to display alphanumeric information in various electronic devices.

IV. RESULT AND DISCUSSION

The implementation of the underground emergency communication system enhances the ability of emergency responders to communicate effectively and coordinate rescue operations in hilly and forest regions. The system provides broader coverage compared to traditional above-ground communication systems, reaching remote areas that were previously inaccessible or underserved. Despite its advantages, the underground emergency communication system may face challenges such as high initial costs, maintenance requirements, and limitations in extreme terrain conditions. Evaluating the cost-effectiveness of the system over its lifespan is crucial, considering factors such as installation costs, ongoing maintenance expenses, and the potential savings from improved emergency response efficiency.

V. CONCLUSION

Diverse organizations in charge to develop disasters management activities at a worldwide level focus on numerous studies for the improvement and formulation of new technologies to facilitate the execution of the procedures necessaries to carry out the disasters management processes in multiplicity hazard scenarios. Technologies can be novels and reliable to manage and plan the preparedness, mitigation and recuperation tasks in disasters. From this perspective, nowadays, the space technology makes available different satellite platforms on-orbit operation that provides the technology resources necessaries to increase and optimize the response capacities to manage the disaster events in their distinct phases. Therefore, the design of the infrastructure, such as emergency communications networks for disaster management by means of the communications satellites and remote sensing satellites integration, inside an operational topology operates in emergency scenarios; it is a novel communications and remote sensing applications platform useful to manage disaster events in all their phases. This type of emergency communications networks is an essential and adequate communications model to enhance the preparedness, mitigation, and recovery of the communications systems which can be affected by disasters, and besides, it is a reliable infrastructure to images capturing and processing in disaster scenarios.

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