Research Article

A Study on A Smart Firefighting Helmet Capable Of Video / Audio Transmission Based On The Firefighting Standard Disaster System

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Abstract: In this paper, in order to effectively respond and rescue lives in a disaster scene, the site and the command center design a smart firefighting helmet to exchange information and make accurate decisions, and propose an algorithm that can transmit and receive video and audio through it. do. Recently, there have been cases in which a rapid response has not been made due to the situation inside the disaster site and delay in communication. So, we propose a design and communication algorithm of a smart firefighting helmet that can transmit voice and video using a firefighting helmet and communicate without a separate radio operation.

Keywords: Firefighting, Helmet, Smart, Wireless Communication, TRS.

1. Introduction

Smart firefighting uses advanced communication systems, sensing, drones, wearable technology, and large-scale data analysis to collect vast amounts of real-time field data, and pass it on to firefighters to make safer and more accurate decisions. In situations such as large-scale fires and explosions, emergency situations such as smoke, collapse and secondary explosions can occur as well as fire, causing fatal consequences for rescue workers as well as rescue operations. Such problems were found in recent large-scale fires in Jecheon, Miryang and Daegu. Delays in response to firemen's in the delivery of information at the site inside the fire and delays in judgment at the site, which can be seen as a lack of communication means due to problems with radio equipment[1]. Frequently, fire fighters can suffer from many injuries and fatalities due to the lack of information about the fire site[2]. Thus, in order to enhance the internalization and efficiency of firefighting activities, this paper proposes the design and communication algorithm of voice recognition-based fire helmets that can deliver voice between the field crew and the control command headquarters without the operation of radio using WiFi and Bluetooth communication.

If the paradigm of the disaster prevention policy in the past was passive disaster management centered on response and recovery, there have been many voices recently calling for a shift to active disaster management centered on prevention and preparedness, which detects risk factors in advance and minimizes damage[3]. Recently, as technologies such as telecommunication, video, and sensor have been applied to disaster safety areas, research on the establishment of effective social disaster prevention system at low cost is being actively conducted. Therefore, each country is striving to utilize ICT technology in the disaster safety field through cooperation between disaster safety-related ministries and science-related ministries[4]. In the command headquarters of special disaster sites, such as natural disasters or large human disaster sites, the integrated command system for firemen's safety and effective command control is very important[5][6]. Once a disaster occur, the occurrence of it may continue and during that stage, there might have other new disasters, new systems are required for safety management and response methods, and in order to effectively respond to and rescue lives at the scene of disasters or fire accidents, the site and command headquarters need a foundation for smooth exchange of information and accurate decision-making [7][8].

2. Theory and formula

This study consists largely of the design of smart fire helmet appearance, the development of voice and image transmission algorithms using radio communication, and the development of control boards to control them, which were verified through experiments.

2.1. Smart firefight helmet design

The design was conducted in accordance with standard guidelines such as heat resistance, appearance, impact, and weight of the existing fire helmet. The camera is capable of operating at -20 to 50 as the standard of the radio, and it can be used for more than 30 minutes per charge, and the weight of the device without helmet is less than 200g so that there is no discomfort when using it. The wireless communication for video and audio transmission uses both the fire network frequency and the disaster network LTE frequency so that communication will not be interrupted at the disaster site.

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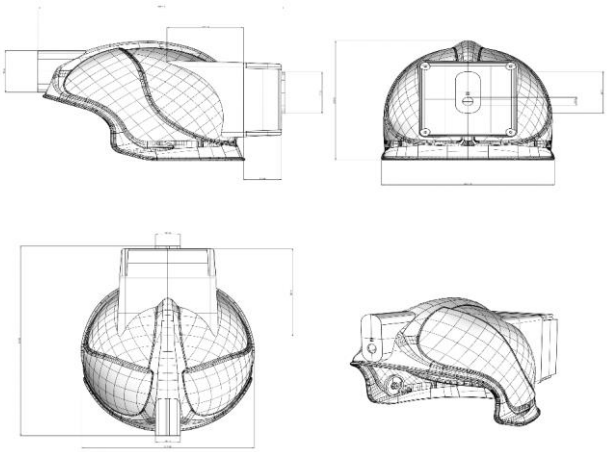

Figure 1. Smart firefight helmet design

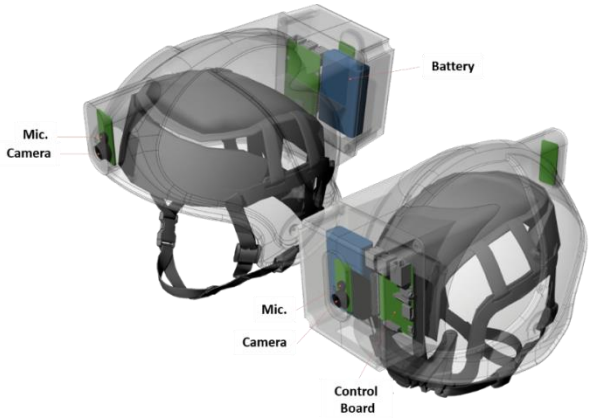

Figure 2. Smart Helmet

2.2. Voice and video transmission algorithm

The algorithm was devised so that the video and audio captured through the camera and headset installed in the smart firefight helmet can be transmitted through the integrated radio (LTE+TRS). The image captured from the camera sensor is compressed in a 200~300kbps (1280*720/15FPS) class H.264 format through a codec in the control board. The compressed image is transmitted / received in a packet communication within the 400~490 MHz frequency band of the TRS radio through the TRS radio voice receiver (RX) and the voice transmitter (TX) through the Bluetooth receiver.

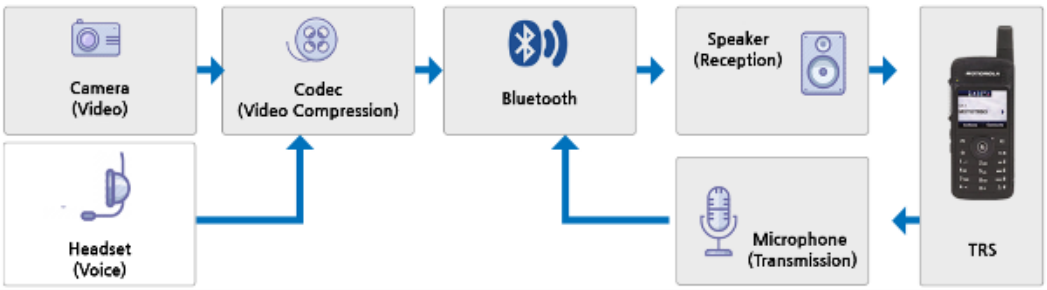

Figure 3. TRS video, voice interlocking plan

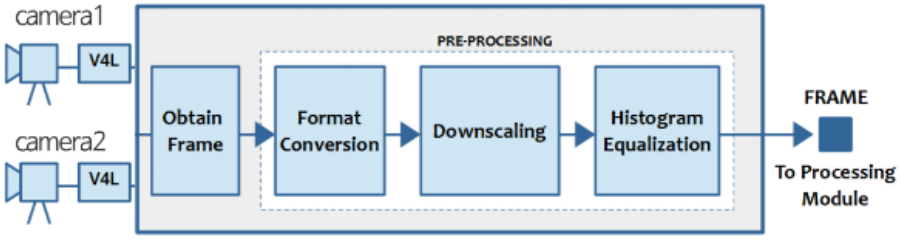

Figure 4. Image compression algorithm

2.3. Firefight helmet control board

The firefighting helmet control board is developed with SOC (Single of Chipset) one-chip structure, which uses hardware based on open platforms at home and abroad and is easy to connect with 3Rd Party products through Open API and SDK. For the connection with the camera, the camera module and a flat cable were used for connection, and the Bluetooth connection was used for the connection with the headset. In the future, the control board will use 10 open source based Xeros Korean speech recognition technologies to define about 10 firefighter radios and apply learning.

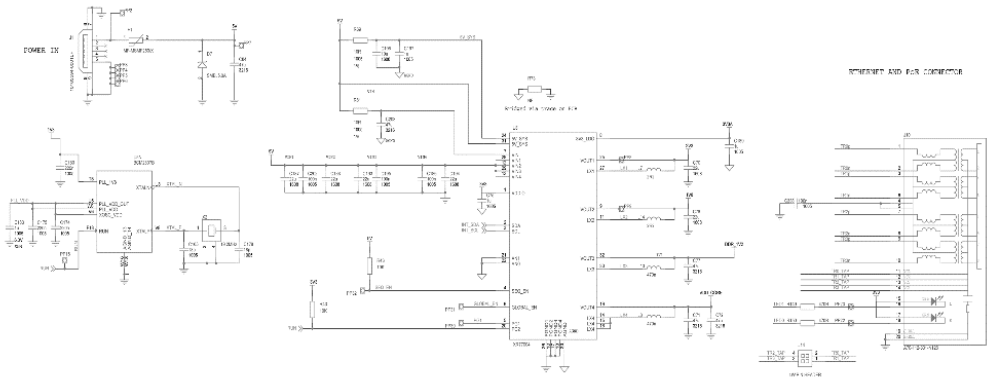

Figure 5. Control board Circuit

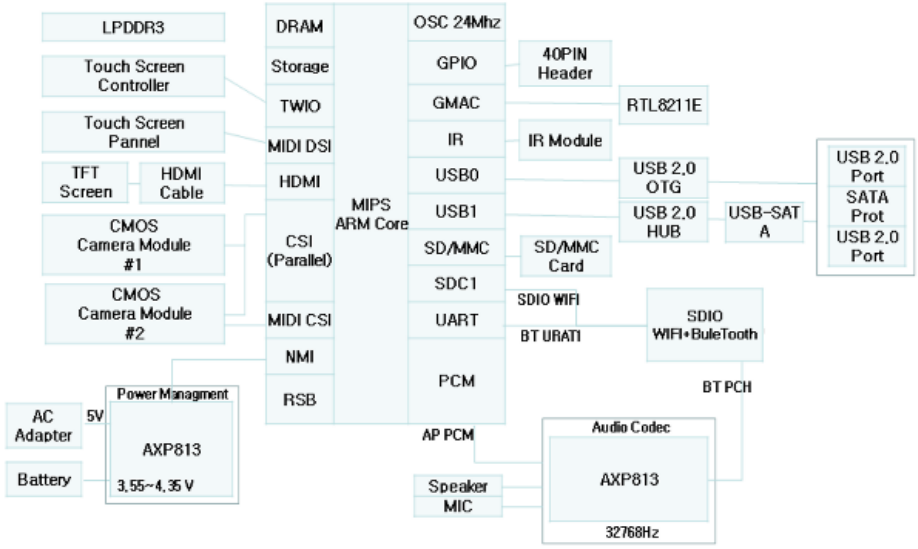

Figure 6. Smart firefight helmet configuration

3. Experimental setup

In order to check the voice transmission and reception using the wireless communication of the proposed firefight helmet, the ‘alsamixer’ command in the embedded control board was generated to check the voice input and output signal strength.

Figure 5. Audio in/out signal test screen

In addition, to check the transmission and reception of the video, the software for the PC and the mobile were produced to check the quality of the transmission and reception.

Figure 6. Real-time smart firefight helmet video

Figure 7. Transmitting images of front and rear cameras via radio

4. Result discussions

In order to effectively respond and rescue lives in a disaster scene, the site and the command center designed a smart firefighting helmet to exchange information smoothly and make accurate decisions, and devised an algorithm that can transmit and receive video and audio. Through the experiment, it was confirmed that the transmission and reception of audio and video is normally performed.

5. Conclusions

The algorithms and devices proposed in this paper will increase the internalization and efficiency of firefighting activities through interlocking with the fire control system in the future, and enable firefighting safety and disaster safety industry activation and standardization of firefighting and disaster response service technologies.

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