Abstract

In this paper, a new application of optical technology is described to implement a low-power-consuming handheld communication terminal and the base station, for human-supporting location-based information services at indoor situations. Human supporting ubiquitous information environment in near future will track and communicate with each user much more continuously, precisely and seamlessly. To keep privacy and security of the users, secured locating and communicating techniques should be required at the wireless channel to reduce information spillover. Spatial optical technology is an attractive solution to realize these requests of less computational power and less power consumption of the user's handheld information terminal.

Concept of a human-supporting handheld information terminal, Aimulet, has been introduced. The Aimulet has some special features of an ultra-low-power consumption, a spatial optical communication, and a simple user interface via button(s) and/or voice I/O. The Aimulet Ver.1, Compact Battery-less Information Terminal (CoBIT) system had been developed. The Aimulet Ver.1 is one of the simplest implementations of Aimulet, which focused on serving voice or sound information, with no primary nor rechargeable batteries. The paper points three subjects and the possible solutions.

To solve the first subject, low-power wireless communication, a new spatial optical communication module, named HV (Hyper Versatile) target was introduced. HV target has two functions of corner-reflection and reflectivity modulation. The HV target has several levels of implementation from simple to complex, and the key device of the target is liquid crystal light modulating device. Characteristics of polymer-dispersion, polymer-networked, and ferroelectric liquid crystals are evaluated. From its low operating voltage (<3V) and insensitivity of light polarization, the polymer-networked liquid crystal light modulator was judged to be the most suitable device for our next version of Aimulet.

To solve the second subject, low-power information multiplex/demultiplex, a new near infrared wavelength division multiplexing technique was employed. Three types of AlGaAs/GaAs LEDs with different center wavelengths of 780nm, 880nm, and 940nm were used to multiplex three contents. Three types of dielectric optical filters of short wavelength (780nm) pass, middle wavelength (880nm) band pass, and long wavelength (940nm) pass, are developed using evaporation technique on polyimide film to discriminate modulated light with each wavelength. Since these dielectric optical filters pass visible light, visible cut layers is evaporated on the backside of the optical filter.

To solve the third subject, a base station with higher performances, new techniques of the beam-steering and parallel data receiving are developed. Two-axis beam steering was realized by a MEMS (micro electro mechanical systems) mirror with gimbals. The mirror has polyimide hinges instead of silicon hinges to increase its steering angle, and is driven by electro-magnetic force instead of electrostatic force to reduce operational voltage of the mirror. Machine vision camera is employed to improve communicating throughput from terminals to a base station. The camera realize both high video frame rate of 1kfps, and lower load average of network than a simple video camera with high frame rate, because the camera has processor and memory on each pixel and can execute various on-chip image pre-processing to get position of the terminal and data from the terminal.

Using these developed techniques, a new Aimulet device with the HV target using a polymer-networked liquid crystal light modulator, and a locating and communicating base station, i-lidar, were developed. Tracking and communicating characteristics of the developed Aimulet system was evaluated, and some demonstration of an indoor location based information service. Content on the public screen was switched with push-button input, attribute (ID) and the user's location.