

IMPLEMENTASI WARNING SYSTEM KEBAKARAN BERBASIS IOT UNTUK PHYSICAL SECURITY DATA CENTER UPA TIK UNDIKSHA

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ABSTRAK

Data *center* merupakan infrastruktur penting yang berfungsi sebagai pusat penyimpanan, pengelolaan, dan distribusi data untuk mendukung layanan teknologi informasi. Salah satu ancaman terhadap *physical security data center* adalah kebakaran yang dapat mengakibatkan kerusakan perangkat, kehilangan data, serta terganggunya operasional. Di UPA TIK Universitas Pendidikan Ganesha, pemantauan kondisi ruang *data center* masih dilakukan secara berkala sehingga berpotensi memperlambat deteksi dini terhadap potensi kebakaran. Penelitian ini bertujuan merancang, mengimplementasikan, dan menguji *warning system* kebakaran berbasis *Internet of Things (IoT)* untuk meningkatkan perlindungan *physical security* pada *Data Center* UPA TIK Undiksha. Metode pengembangan yang digunakan adalah *Waterfall* yang meliputi tahap analisis kebutuhan, perancangan, implementasi, pengujian, dan pemeliharaan. Sistem dikembangkan menggunakan mikrokontroler ESP32 yang terintegrasi dengan sensor *Flame 5 Channel*, MQ2, dan DHT21 untuk mendeteksi api, asap, suhu, serta kelembapan. Komunikasi data menggunakan protokol MQTT, sedangkan aplikasi *mobile* dibangun menggunakan *Flutter* dengan *Firestore* sebagai *backend*. Penentuan tingkat bahaya dilakukan menggunakan algoritma *Decision Tree* yang mengklasifikasikan kondisi lingkungan ke dalam lima level bahaya. Hasil pengujian menunjukkan bahwa seluruh fungsi sistem berjalan sesuai kebutuhan. Algoritma *Decision Tree* berhasil mencapai tingkat akurasi 100% pada 40 skenario pengujian. Protokol MQTT mampu mengirimkan data dengan rata-rata waktu tunda sekitar 1 detik sehingga mendukung *monitoring* secara *real-time*. Selain itu, sistem berhasil memberikan peringatan dini melalui *buzzer*, tampilan OLED, dan notifikasi aplikasi *mobile* sesuai tingkat bahaya yang terdeteksi. Dengan demikian, sistem yang dikembangkan mampu meningkatkan efektivitas pemantauan serta mendukung perlindungan *physical security* pada *Data Center* UPA TIK Undiksha.

Kata Kunci: *Internet of Things, Warning System, Data Center, Physical Security, Decision Tree, MQTT*

IMPLEMENTATION OF AN IOT BASED FIRE WARNING SYSTEM FOR THE PHYSICAL SECURITY OF THE UPA TIK UNDIKSHA DATA CENTER

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ABSTRACT

Data centers are critical infrastructure that serve as hubs for the storage, management, and distribution of data to support information technology services. One of the threats to the physical security of a data center is fire, which can result in equipment damage, data loss, and operational disruptions. At the UPA TIK of Ganesha University of Education, monitoring of data center conditions is still conducted periodically, which has the potential to delay early detection of potential fires. This study aims to design, implement, and test an Internet of Things (IoT)-based fire warning system to enhance physical security protection at the UPA TIK Undiksha Data Center. The Waterfall development method was used, encompassing the stages of requirements analysis, design, implementation, testing, and maintenance. The system was developed using an ESP32 microcontroller integrated with a 5-Channel Flame sensor, an MQ2 sensor, and a DHT21 sensor to detect fire, smoke, temperature, and humidity. Data communication uses the MQTT protocol, while the mobile app was built using Flutter with Firebase as the backend. Hazard levels are determined using a Decision Tree algorithm that classifies environmental conditions into five hazard levels. Test results show that all system functions operate as intended. The Decision Tree algorithm achieved 100% accuracy across 40 test scenarios. The MQTT protocol is capable of transmitting data with an average latency of approximately 1 second, thereby supporting real-time monitoring. Additionally, the system successfully provides early warnings via a buzzer, an OLED display, and mobile app notifications based on the detected hazard level. Thus, the developed system enhances monitoring effectiveness and supports physical security at the UPA TIK Undiksha Data Center.

Keywords: Internet of Things, Warning System, Data Center, Physical Security, Decision Tree, MQTT.