SECURITY MONITORING SYSTEM IN SMART WAREHOUSE USING RASPBERRY PI AND IOT

[1]Muhamad Fadillah, [2]Drs. Tatang Mulyana, M.T., Ph.D., [3]Haris Rachmat S.T., M.T.
[1, 2,3]Industrial Engineering, School of Industrial Engineering, Telkom University
[1]muhamad.fadillah723@gmail.com, [2]tatangmulyana@telkomuniversity.ac.id,
[3]harisrachmat@telkomuniversity.ac.id

Abstract

Along with the increasing use of warehouse in manufacturing activities, a system that can provide information about the warehouse is needed. This information is used as a reference in determining the condition and level of security that occurs on the warehouse. Security monitoring system for smart warehouse is a warehouse which is integrated with communication network using electrical equipment that can be controlled and monitored or accessed remotely. In this research will be to develop the system through parameter determination, device construction and device testing. In several condition in warehouse to be parameter that are lock-unlock door, smoke, in-out worker and worker movement. Device has several component such as Raspberry Pi 3, RFID, Magnetic Door Sensor, MQ-2 Gas Sensor, PIR Sensor, Buzzer, LED, Raspberry GPIO Extender, PCF8591 and the software for support the device is consist of Python IDE, MySQL, PhpMyAdmin, and Blynk. Testing will be done in mockup as warehouse, the testing is carried out until get the enough data, the test consists of open-close door of mockup, tap the RFID card to scanner in mockup, make smoke in mockup, make a movement in mockup. The methodology divided by 3 phases, there are initial phase, assembly phase and testing phase. The first phase includes getting information related security monitoring, sorting the information to make list of component system, and buy the component based the list. Second phase consist of checking the component, create a design and assembly the component based on design, and make the program for support the activities of system. The last phase is upload and run the program, waiting the calibration of sensor and collect the data result. The result from the testing system are the entry and exit data is collected by 31 data, it consist of name, time entry and time exit. This data is recorded in database raspberry, and to get the data just download the csv file from phpmyadmin via laptop. The data smoke condition, open/closed door condition, movement worker, and status safe/unsafe condition will be displayed in the realtime in smartphone with the word of "No Smoke Detected" or "Smoke Detected", " Door is Open" or "Door is Closed", "Motion Detected" or "No Motion Detected", and "Safe Condition" or "Unsafe Condition". Based on the testing the device is working correctly with the parameter that has been configure.

Keyword : security, monitoring, system, warehouse, raspberry pi, IoT.

1. INTRODUCTION

Along with the increasing use of warehouse in manufacturing activities, a system that can provide information about the warehouse is needed. This information is used as a reference in determining the condition and level of security that occurs on the warehouse. Security monitoring system for smart warehouse is a warehouse which is integrated with communication network using electrical equipment that can be controlled and monitored or accessed remotely. The main purpose of creating a warehouse into provide comfort to the security staff in terms of controlling and monitoring the state of warehouse [1].

Warehouse is part of the company's logistics system as a place to store goods (raw materials, parts, intermediate goods, finished goods) at and between the place of origin and destination and provide information to management about the status, conditions, and disposition of items being stored [2]. Security in any objective sense, measures the absence of threat to acquired values, in a subjective sense, the absence of fear that such values will be attacked [3]. Theft according to Lili Rassidi is the act of someone who takes other people's property without permission and causes someone to suffer a loss and according to M. Thahir Ashari, Theft is an action carried out by a person or group of people that causes another person to lose and the act is unlawful.

Internet of things (IoT) connects all objects that are in the human environment such as washing machines, televisions, security systems and others; by using the internet. It makes it easy for users to access all the information wherever they are [4]. There are various applications that use this technology. It facilitates the management of human life. For example, in fire control in the jungle that uses the detector network to monitor the temperature to prevent sudden forest fires [5]. Based on data from the central statistics agency, there are many cases of theft, warehouse security needs to be considered, so a design of a security monitoring system that was made, it will be used raspberry pi as a processing module, there are several sensors, namely the proximity infrared sensor as a motion sensor reader from humans and animals, magnetic door sensor as a sensor for detecting the door of warehousein open/close conditions, MQ2 gas sensor as a smoke detection sensor, Radio-Frequency Identification as a data collector of anyone entering and exit the warehouse. After all data from each sensor is received and processed, the data will be sent to a cloud that can be accessed by any warehouse user or admin using a smartphone application. So, an idea arise that could design a monitoring system for warehouse security with the title " Monitoring Security System In Smart Warehouse Using Raspberry Pi and IoT".

2. LITERATURE REVIEW

2.1 Raspberry Pi 3B

Raspberry Pi 3 is a single-board computer with wireless LAN and Bluetooth connectivity. It is the earliest model of the third-generation Raspberry Pi. It replaced the Raspberry Pi 2 in February 2016. The specification of raspberry pi 3 are Quad Core 1.2GHz Broadcom BCM2837 64bit CPU, 1GB RAM, BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board, 100 Base Ethernet, 40-pin extended GPIO, 4 USB 2 ports, 4 Pole stereo output and composite video port, Full size HDMI, CSI camera port for connecting a Raspberry Pi camera, DSI display port for connecting a Raspberry Pi touchscreen display, Micro SD port for loading your operating system and storing data, Upgraded switched Micro USB power source up to 2.5A[6].

2.2 Magnetic Door Sensor

This sensor is essentially a reed switch, encased in an ABS plastic shell. Normally the reed is 'open' (no connection between the two wires). The other half is a magnet. When the magnet is less than 13mm (0.5") away, the reed switch closes. They're often used to detect when a door or drawer is open, which is why they have mounting tabs and screws. You can also pick up some double-sided foam tape from a hardware store to mount these, that works well without needing screws [8].

2.3 RFID

RFID system consists of three components namely transponder (tag), interrogator (reader) and computer containing the database. The interrogator reads the tag data and transmits it to the computer for authentication. The information is processed and upon verification, access is granted. Depending upon the source of electrical energy, RFID tags are classified as either active or passive. The active tags use a battery for powering the circuit on the tag and transmit the task information upon the reader request. However, these tags are very expensive and seldom used. On the other hands, passive tags get energy from the reader to power their circuit. These tags are very cost-effective and hence most of the applications use them.

2.4 PCF8591

The PCF8591 is a single-chip, single-supply low-power 8-bit CMOS data acquisition device with four analog inputs. The functions of PCF8591 is 8-bit analog-to-digital conversion and an 8-bit digital-to-analog conversion [6].

2.5 MQ2 Gas Sensor

The Grove - Gas Sensor (MQ2) module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer. This is an Analog output sensor. It needs to be connected to any one Analog socket in Grove Base Shield. It is possible to connect the Grove module to Arduino directly by using jumper wires. The output voltage from the Gas sensor increases when the concentration of gas increases. Sensitivity can be adjusted by rotating the potentiometer. The best preheat time for the sensor is above 24 hours [9].

2.6 PIR Sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) radiation being emitted from objects in its field of view. They are most often used in PIR-based motion detectors. When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves [10].

2.7 Python

Python is a programming language. Python is used for software development [9].

2.8 Blynk

Blynk is an application for iOS and Android OS to control Arduino, NodeMCU, Raspberry Pi and the likes over the Internet. This application can be used to control hardware devices, display sensor data, store data, visualization, and others [10].

2.9 IoT

Internet of Things (IoT) is a concept / scenario where an object can transfer data over a network without requiring human-to-human or human interaction to a computer [11].

2.10 Database

A database is an organized collection of data, generally stored and accessed electronically from a computer system. Where databases are more complex, they are often developed using formal design and modeling techniques. The database management system (DBMS) is the software that interacts with end users, applications, and the database itself to capture and analyze the data.

3. RESEARCH METHODOLOGY

To produce output in accordance with the objectives of the study, it is needed a flow chart that serves to describe the concept of problem solving in a structured way. flow chart for testing can be seen Figure 3.1.

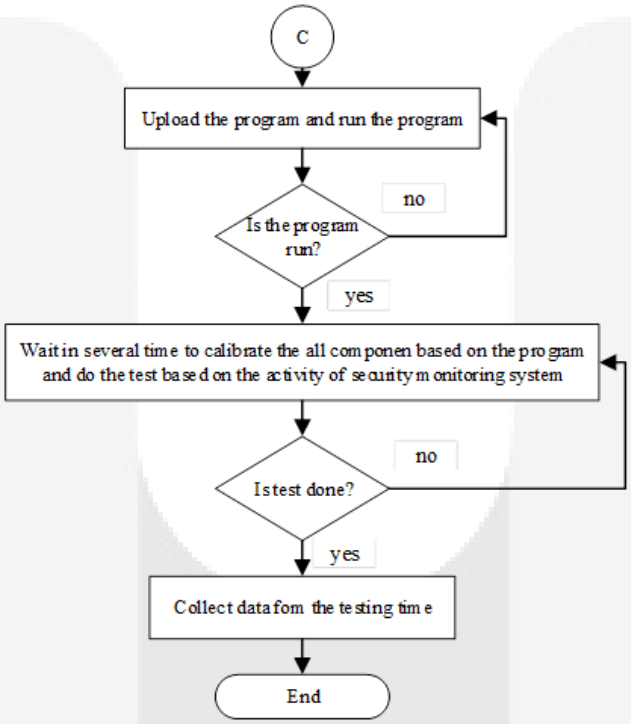

Figure 3. 1 Research Methodology

On the Figure 3.1, run and test flow chart we can see the process flow after starting the system, where we will upload the program and run the program. When the program runs and there is no indication of error, we wait a while for all sensors to calibrate in accordance with the program that we have run. After the program runs, we will conduct a trial based on the activity flow for the security monitoring system. After doing all the process flow in the trial we will collect the results of the trial and the work activity ends.

4. RESULT AND DISCUSSION

a. Entry Worker Data

Table IV.1 is the data that obtained from the RFID scanner in database. Data collection conducted on one day. The data contained name of worker and time entry, so there are as many as 31 pieces of data.

Table 4. 1 Entry Worker Data

ID	RFID ID	Name	Time Entry
259	4,58E+11	Jessica Apriliani	10/10/2019 02.08
260	9,84E+11	Reza Aqram	10/10/2019 02.08
261	1,62E+11	Rizal Wardhani	10/10/2019 02.09
262	7,86E+11	Annisa Aulia	10/10/2019 02.09
263	5,03E+11	Muhamad Fadillah	10/10/2019 02.10
264	7,8E+11	Maulidan Khoir	10/10/2019 02.13
265	4,58E+11	Jessica Apriliani	10/10/2019 02.14
266	9,84E+11	Reza Aqram	10/10/2019 02.14
267	7,86E+11	Annisa Aulia	10/10/2019 02.14
268	5,03E+11	Muhamad Fadillah	10/10/2019 02.14
269	1,62E+11	Rizal Wardhani	10/10/2019 02.14
270	7,8E+11	Maulidan Khoir	10/10/2019 02.14
271	4,58E+11	Jessica Apriliani	10/10/2019 02.14
272	1,62E+11	Rizal Wardhani	10/10/2019 02.14
273	9,84E+11	Reza Aqram	10/10/2019 02.14
274	7,8E+11	Maulidan Khoir	10/10/2019 02.15
275	4,58E+11	Jessica Apriliani	10/10/2019 02.15
276	5,03E+11	Muhamad Fadillah	10/10/2019 02.15
277	1,62E+11	Rizal Wardhani	10/10/2019 02.15
278	7,86E+11	Annisa Aulia	10/10/2019 02.15
279	9,84E+11	Reza Aqram	10/10/2019 02.16
280	7,8E+11	Maulidan Khoir	10/10/2019 02.16
281	5,03E+11	Muhamad Fadillah	10/10/2019 02.16
282	1,62E+11	Rizal Wardhani	10/10/2019 02.16
283	7,86E+11	Annisa Aulia	10/10/2019 02.16
284	4,58E+11	Jessica Apriliani	10/10/2019 02.16
285	5,03E+11	Muhamad Fadillah	10/10/2019 02.16
286	7,8E+11	Maulidan Khoir	10/10/2019 02.16
287	9,84E+11	Reza Aqram	10/10/2019 02.17
288	7,8E+11	Maulidan Khoir	10/10/2019 02.17
289	5,03E+11	Muhamad Fadillah	10/10/2019 02.17

Data in the data entry table is obtained when a worker will enter the warehouse by attaching the rfid card to the rfid scanner available in front of the warehouse. Data will be recorded in the database and will be exported to be read and analyzed in CSV format. This data shows the data number, rfid card number, name on the rfid card and the time the person entered into the warehouse.

b. **Exit Worker Data**

Table 4.2 is the data that obtained from the RFID scanner in database. Data collection conducted on one day. The data contained name of worker and time entry, so there are as many as 31 pieces of data.

Table 4. 2 Exit Worker Data

ID	RFID ID	Name	Time Exit
94	7,86E+11	Annisa Aulia	10/10/2019 02.09
95	1,62E+11	Rizal Wardhani	10/10/2019 02.09
96	9,84E+11	Reza Aqram	10/10/2019 02.09
97	4,58E+11	Jessica Apriliani	10/10/2019 02.09
98	5,03E+11	Muhamad Fadillah	10/10/2019 02.11
99	4,58E+11	Jessica Apriliani	10/10/2019 02.14
100	7,8E+11	Maulidan Khoir	10/10/2019 02.14
101	7,86E+11	Annisa Aulia	10/10/2019 02.14
102	5,03E+11	Muhamad Fadillah	10/10/2019 02.14
103	1,62E+11	Rizal Wardhani	10/10/2019 02.14
104	4,58E+11	Jessica Apriliani	10/10/2019 02.14
105	7,8E+11	Maulidan Khoir	10/10/2019 02.14
106	1,62E+11	Rizal Wardhani	10/10/2019 02.14
107	9,84E+11	Reza Aqram	10/10/2019 02.14
108	9,84E+11	Reza Aqram	10/10/2019 02.15
109	7,8E+11	Maulidan Khoir	10/10/2019 02.15
110	5,03E+11	Muhamad Fadillah	10/10/2019 02.15
111	1,62E+11	Rizal Wardhani	10/10/2019 02.15
112	7,86E+11	Annisa Aulia	10/10/2019 02.15
113	4,58E+11	Jessica Apriliani	10/10/2019 02.15
114	7,8E+11	Maulidan Khoir	10/10/2019 02.16
115	9,84E+11	Reza Aqram	10/10/2019 02.16
116	5,03E+11	Muhamad Fadillah	10/10/2019 02.16
117	4,58E+11	Jessica Apriliani	10/10/2019 02.16
118	7,86E+11	Annisa Aulia	10/10/2019 02.16
119	1,62E+11	Rizal Wardhani	10/10/2019 02.16
120	7,8E+11	Maulidan Khoir	10/10/2019 02.16
121	5,03E+11	Muhamad Fadillah	10/10/2019 02.17
122	5,03E+11	Muhamad Fadillah	10/10/2019 02.17
123	7,8E+11	Maulidan Khoir	10/10/2019 02.17
124	9,84E+11	Reza Aqram	10/10/2019 02.17

The data in the data exit table records the traces of workers leaving the warehouse by re-attaching the employee's rfid card to the rfid scanner available in front of the warehouse. This data can be read and analyzed in CSV format through the export process. This data shows the data number, rfid card number, name on the rfid card and the time the person exited into the warehouse.

5. CONCLUSION

Based on the result has been done on the construct of device security monitoring system, the following conclusions are obtained :

1. Parameter determination is open/close door, smoke, in-out worker and worker movement. Magnetic door sensor uses to get the open/close door condition of warehouse, MQ-2 Gas Sensor use to detect smoke in warehouse, RFID is used to tap the rfid card of worker while in or out the warehouse, and PIR Sensor for detect the movement in warehouse. After testing we get data open/close door condition, data smoke condition, data entry and exit worker, data worker movement. The data open/close condition will displayed on blynk application in smartphone that has integrated with the device. It show the word of “Door is open” mean the door is open or ”Door is close” mean the door is closed. The data smoke condition will displayed in the smartphone with the word of “No smoke detect” or ”Smoke detect”. The displayed of word “Motion detect” or “No motion detect” for the data of movement worker. Result of analysis for the open/closed door condition give the information the door condition to security staff so make them easier to checking the warehouse. Smoke condition give information about posibility of smoke that has potential to make fire in the warehouse. The data entry and exit worker is showed who and when the worker are entry or exit the warehouse. This data is taken in 31 data with the register worker is 6 in the database of worker. The movement worker data showed the condition of the warehouse is there any body inside or not.
2. To assembly the system is divided by several modul, which are visitor system, smoke detection, movement detection, open/closed door module, alarm module, and indicator status module. The all modul is created in schematic diagram use fritzing as the software of wiring design. Each modules will be integrate in 1 schematic which is schematic diagram of security monitoring system. This diagram will be make a device where the wiring is wire in breadboard. In interpretating the warehouse is used a mockup as warehouse prototype to show the working of device. The design of mockup created by engineering drawing use solidwork software. Mockup consist of 7 part which are the box of mockup, door, hinge, rfid, mq2 gas sensor, pir sensor and magnetic door sensor. It dimension is 40x40x40 cm and made by arclylic material. After it is created then device is ready to install in the mockup. Mockup that has finish install with the device will be turn on and make some program with compare all parameter that has been configure. While created the program, several application is used which are phpmyadmin and python. Phpmyadmin is used to make a database for record the entry and exits data has collected by RFID scanner using mySQL language. Python is used to make some program for MQ2 gas sensor, PIR sensor and magnetic door sensor. The result of the running program will be send in blynk server, it accessed in smartphone that has integrated with the device.
3. While the program running, wait in several time to get the all sensor calibrate. There are several condition in initial stage which are door lock status, no motion, no smoke, no alarm, and no recorded data entry or exit in database. The data entry will be collected while the worker tap the RFID card to RFID scanner, after it recorded in database the door status will be change to unlock condition, and the parameter will be mention just smoke condition. If the worker doesn’t tap the RFID card, the all initial stage will be consider again. If it change the alarm will be on to mention the security staff if the warehouse is not safe and sending the data to blynk server and accesed by smartphone. While the unlock condition and there are smoke in warehouse than it will be turn on the alarm and sending data to the smartphone. After several time and worker will be exit the warehouse, the worker must be tap again the RFID card to RFID scanner and it will change the initial stage status. The testing result consist of entry and exit worker, smoke condition, door open/close condition, movement worker and status safe/unsafe condition in the smartphone. The entry and exit data is collected by 31 data, it consist of name, time entry and time exit. This data is recorded in database raspberry, and to get the data just download the csv file from phpmyadmin via laptop. The data smoke condition, open/closed door condition, movement worker, and status safe/unsafe condition will be displayed in the realtime in smartphone with the word of “No Smoke Detected” or “Smoke Detected”, “ Door is Open” or “Door is Closed”, “Motion Detected” or “No Motion Detected”, and “Safe Condition” or “Unsafe Condition”. Based on the testing the device is working correctly with the parameter that has been configure.

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