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Monitoring cameras for violations in the use of personal protective equipment

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ABSTRACT

Work Safety is an activity and effort to create a safe work environment, preventing all forms of accidents. To implement safe actions for workers, Personal Protective Equipment (PPE) is needed for workers to protect someone in doing their work. This Personal Protective Equipment (PPE) monitoring system begins by turning on the system by flowing the power supply to the system. Then the system is set via an access point via WiFi to be able to set the system on the microcontroller GUI. Then by selecting to activate "Motion Detect" and "Auto Upload" on the GUI, the system will automatically detect all movements within the range of the camera sensor. Furthermore, the system saves the video image of the object's movement in the memory on the system and will then be uploaded to a personal computer that has been set as an FTP server. After the personal computer saves the video image, the personal computer then sends the video image to the roboflow platform server. And when the video image is sent to the roboflow platform server, the video image is classified and labeled according to the dataset that the author created in the previous python programming. And finally, the video image that has been classified and labeled is stored again in the directory that has been specified in the programming.

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1. INTRODUCTION

In its application in the field, it is often found that in a job there are several workers who do not comply with work regulations, one of which is the application of the use of Personal Protective Equipment (PPE) for workers to protect workers in doing their jobs. Personal Protective Equipment (PPE) is work equipment that must be worn by workers in certain work environments with the aim of reducing the impact of existing work hazards [1]-[4]. In general, occupational safety and health is a way to apply oneself or regulate oneself in a job so that one can work safely and healthily both individually in a job so that one can work safely and healthily both physically and mentally related to the work process and work environment

Personal Protective Equipment (PPE) is a tool that functions to have the ability to protect a person whose function is to isolate part or all of the body from potential hazards in the workplace. In the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia No.PER.08/MEN/VII/2010 article 6 paragraph 1, namely that workers/laborers and other people who enter the workplace are required to wear or use Personal Protective Equipment (PPE) according to the potential hazards and risks, while in article 6 paragraph 2 states that workers/laborers have the right to express objections to doing work if the Personal Protective Equipment (PPE) provided does not meet the needs and requirements [5]. The purpose of using personal protective equipment (PPE) is to protect workers and the risk of physical injury by creating a barrier from hazards in the workplace.

In this problem, a Health, Safety, and Environment (HSE) team and field supervision are needed to monitor and remind workers to always wear complete Personal Protective Equipment (PPE) and in accordance with applicable regulations in the workplace. To optimize supervision of users of Personal Protective Equipment (PPE) in the work environment, the author developed this system to facilitate supervision in the field or the HSE team to monitor activities using the XIAO SEED ESP32S3 Microcontroller with the help of computer vision technology through the roboflow platform integrated with the File Transfer Protocol (FTP) server. It is not effective and efficient to rely only on human ability to count the number of each worker, whether they are wearing complete PPE or not. Therefore, technology is needed that can provide information about workers who are wearing PPE or not. To recognize objects to be monitored, the help of technology in the form of Computer Vision is needed. Computer Vision is a computer science that works by imitating human visual abilities. With Computer Vision, Object Detection can work to recognize objects in images and the location of objects [6]-[10]. One of the developments for Object Detection is using Deep Learning, namely Only Look Once (YOLO), the convolutional layer will occur in the convolution process in each network [11]-[15]. By using the YOLO algorithm, it is expected to provide good results as a basis or reference for creating a monitoring system that can help project management in real time and mitigate work accidents in a construction or mining project.

2. METHOD

This design illustrates how the overall hardware or tool design is used to run the Personal Protective Equipment (PPE) Violation Monitoring Camera System. Figure 1 shows the PPE design using a monitor camera.

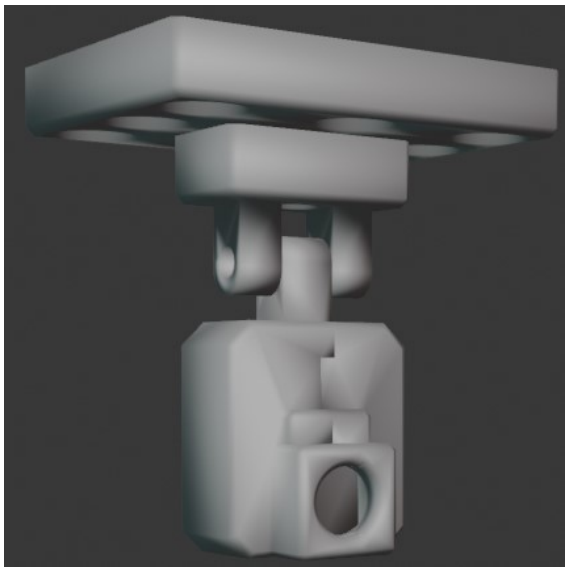

Figure 1. The proposed PPE monitoring system

The Personal Protective Equipment (PPE) violation monitoring system in this study consists of 2 components, namely hardware components and server components. The hardware component explains how the process of monitoring the violation of personal protective equipment (PPE) processes the data taken. While the server component explains how when a personal computer detects a new file in a predetermined directory, the video image is then uploaded to the roboflow platform so that the gambit is classified and labeled according to the data collection on the platform. Figure 2 shows a block diagram of the proposed system.

The way PPE works in this study begins by turning on the system by connecting the hardware device to the source. Then the system is set via access point via wifi for data to set the system on the microcontroller gui. Then by selecting to activate "Motion Detect" and "Auto Upload" on the GUI, the system will automatically detect all movements within the range of the camera sensor. Furthermore, the system stores video images of the object's movement in the memory on the system and will then be uploaded to a personal computer that has been set as an FTP server.

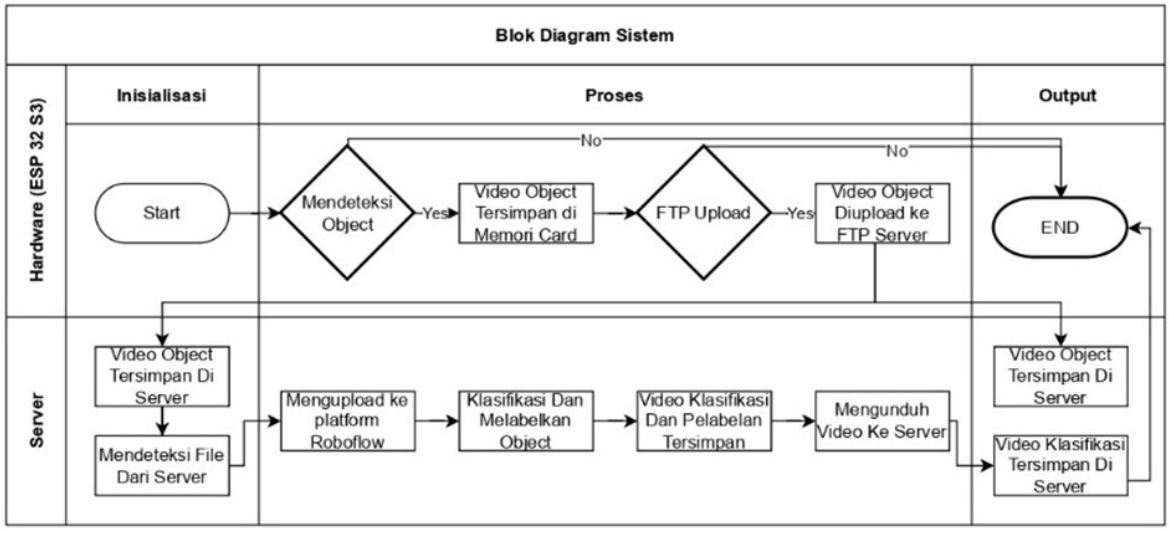

Figure 2. Diagram block of the proposed PPE monitoring system

The flowchart in Figure 3 shows that this monitoring system is divided into 2 parts. The parts consist of the hardware process and the server process. In the hardware process, the XIAO SEEED ESP32 S3 microcontroller camera is set according to system requirements by accessing the GUI (Graphical User Interface) of the microcontroller using an Access Point via WiFi. After being set automatically, the hardware system will capture video images if it detects an object that is reached by its camera sensor and is automatically stored in the system device's memory. Furthermore, FTP upload will automatically run if it has been set automatically in the previous GUI and the system will continue to upload video images to the FTP server (personal computer). Furthermore, in the Server Process, after the personal computer detects the video, the personal computer uploads the video back to the roboflow platform server so that the video image is classified and labeled according to the previously selected dataset. Finally, the classification and labeling process is complete, then the processed video image is sent back to the server (personal computer) and stored in the specified directory.

In the server system configuration and programming process, there are three parts, each of which explains each item on the server system used. File Transfer Protocol (FTP) is still the favorite media used to transfer files over the internet network. The goal is to replace the data exchange system that uses storage devices in the form of flash drives or external hard drives to make data exchange using the FTP system using a wireless network [6]. By building an FTP system that uses a wireless network so that not only computer devices can connect to the FTP server but smartphone devices can also connect to the FTP server using a wireless network and with file extension restrictions so that cient cannot upload files and download files in the form of file extensions that are not permitted by the server.

Here are the steps to activate the FTP Server on a personal computer. First, open the Control Panel on the Personal Computer then click on "Programs". Second, then select "Turn Windows Features On Or Off". Third, then, Window Features, drag the cursor down then select the Internet Information Services Hostable Web Core feature and check the box provided and do not immediately click OK. Fourth, then, select the Internet Information Services feature and select expand. In the FTP Server settings, select the option will appear - expand. Add and check the FTP Service feature in the box provided. Fifth, By selecting the Internet Information Services feature, select Web Management Tools. Add and check the IIS Management Console box. Sixth, Click OK and exit the feature window. Wait a few minutes for the process to get a message. Seventh, Once finished, reopen the Control Panel and change the View By setting to the Small Icons option. Eight, Select Windows Tools. Nine, Double-click on Internet Information Services (IIS) Manager. Ten, Next, open the window and select the Connections feature down, find the name of your computer's location. Click the Right-click On The Sites setting and select Add FTP Site. Eleven, In the Add FTP Site window, enter the FTP site name and find or enter the Physical path: for the folder you are using. Then select Next. Twelve, Next, the Binding and SSL Settings window, open and continue down, select the IP Address menu and select your IP address. then, select SSL, click on No SSL. Then select Next. And finally, the next window then click finish on the dialog window.

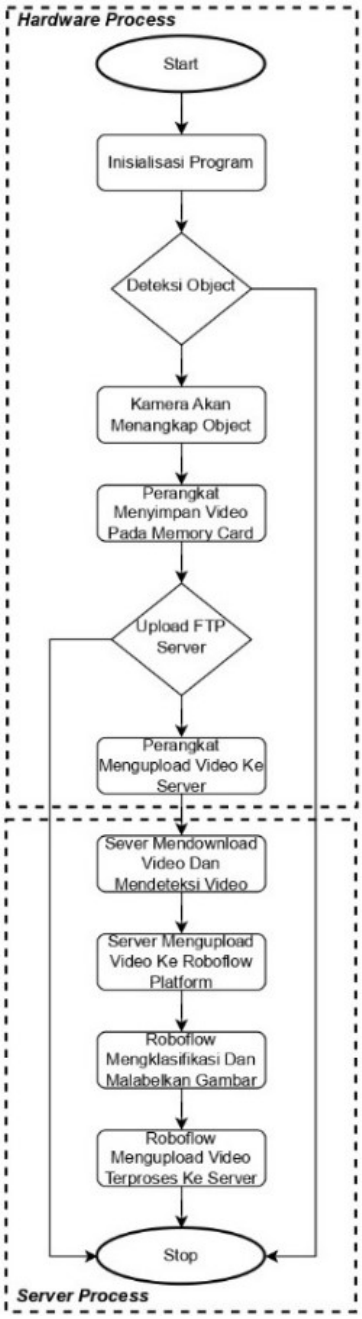

Figure 3. Flowchart of the proposed PPE monitoring system

After setting the personal computer as an FTP server, the next step is to allow FTP with the firewall system on the personal computer. A firewall is a tool to implement security policies. Meanwhile, security policies are made based on considerations between the facilities provided and their security implications. The tighter the security policy, the more complex the configuration of information services or the fewer facilities available on the network. So what goes in and out of the firewall must be acceptable. A firewall is a combination of routers, servers, and the right complementary software [7].

The steps are the first Open the control panel, then click view by - small icons then click windows defender firewall. Second, In the windows defender firewall window, select Allow a program (an app) or feature through Windows Firewall. Third, In the next window, if necessary click on change settings at the bottom to change the previous settings. And finally, scroll down and find the FTP Server location settings. Check Privet in the box provided then click Ok. And open all existing windows. Note: if the computer is on a domain and you are using a domain user to log in to the FTP site, make sure the Domain box is also checked.

3. RESULTS AND DISCUSSION

This stage is carried out by testing the FTP Server to classify and label the system using the roboflow platform. At this stage there are three steps taken. The first is to run the entire program created in Visual Basic, the second is to enter the image in the specified directory and the third is to see the classification results from the roboflow platform. The first and second parts explain how the program that has been created can run during testing, as well as when entering images. Before entering images, the images are classified and labeled according to the dataset selected on the robloflow platform itself. Before being classified, the image is entered as a sample image in a directory named the file "C: Alarm" on the FTP Server system itself, as shown in Figure 4.

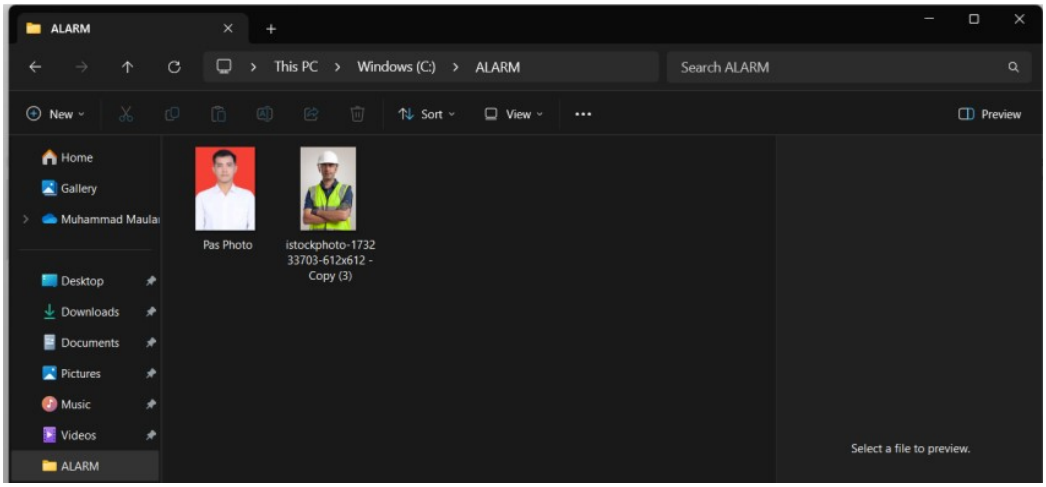

Figure 4. Adding Images to the FTP Server Directory

After entering the image in the specified directory, the system will automatically detect the images that have just been added to the directory and will classify the images and label them. The results are shown in Figure 5 below.

Figure 5. Results of Personal Protective Equipment (PPE) Usage Detector Test

In the image above, the first image shows that the system detects 4 classification classes, namely "Person" or human, "No-Mask" or not wearing a mask, "No-Hardhat" or not wearing a helmet, and "No-Safety Vest" or not wearing a vest or project clothes. And the automatic labeling of this platform is in accordance with the actual image visualization when viewed from the normal human eye. The same is true for the second image which detects 4 classes, namely "Person" or human, "No-Mask" or not wearing a mask, "Hardhat" or wearing a helmet, and "Safety Vest" or wearing a vest or project clothes. However, in the second image, the system reads objects with the class "Hardhat" or wearing a helmet twice and does not match the actual visualization. In the hardware system configuration and programming process, there are three parts, each of which explains how each item in the hardware system can run properly. In the XIAO SEED ESP32S3 Camera programming, it explains how the microcontroller works. There are three parts in the XIAO SEED ESP32 S3 Cam programming. The first is the Declaration in the form of a storage preparation function with a micro SD, a function to load previously stored user configurations and a camera initialization function. Second, the Declaration of the storage preparation function with the function to connect wifi and the function of the features on the microcontroller gui. And finally, the Declaration in the form of a storage preparation function with the function to confirm that there are no obstacles in the setup. Where each step has its own role to declare so that the tool can work properly.

When performing the initial initialization, the XIAO SEEED ESP32 S3 microcontroller is first configured by accessing the microcontroller GUI using an access point via the WiFi network provided on the microcontroller. The steps are to provide a power supply to the microcontroller and connect the device, either a cellphone or laptop, to the WiFi network available from the system. After connecting the Microcontroller Access Point via WiFi, the next step is to access the microcontroller GUI with a web browser with the IP address specified in the system, as shown in Figure 6.

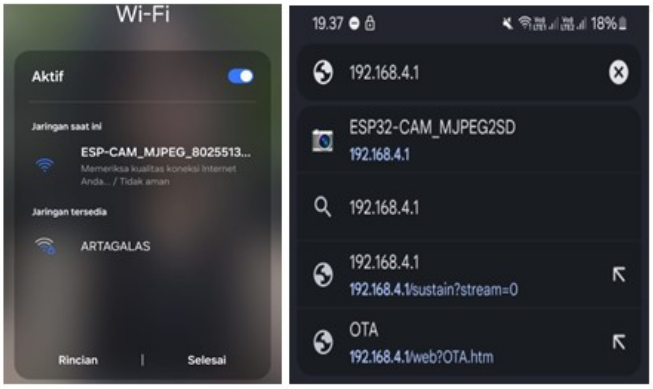

Figure 6. Motion Sensitivity Settings on the System GUI

After configuring the entire system on the hardware GUI, the next step is testing the hardware system. In this section there are two steps in testing, the first is testing the autodetect system. Which in this test is done by pointing the camera sensor to the object to be detected, as shown in Figure 7.

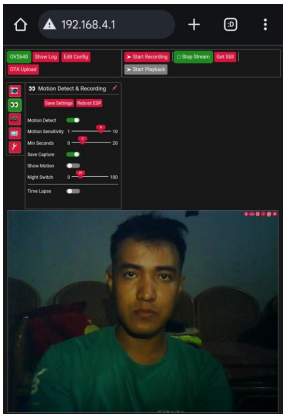

Figure 7. Motion Sensitivity Settings on the System GUI

The second is to perform motion detection testing while still and moving. This test is done by resetting the GUI on the system by activating the "Show Motion" option and the test results when the object is still and the camera sensor does not detect movement are obtained as shown in Figure 8..

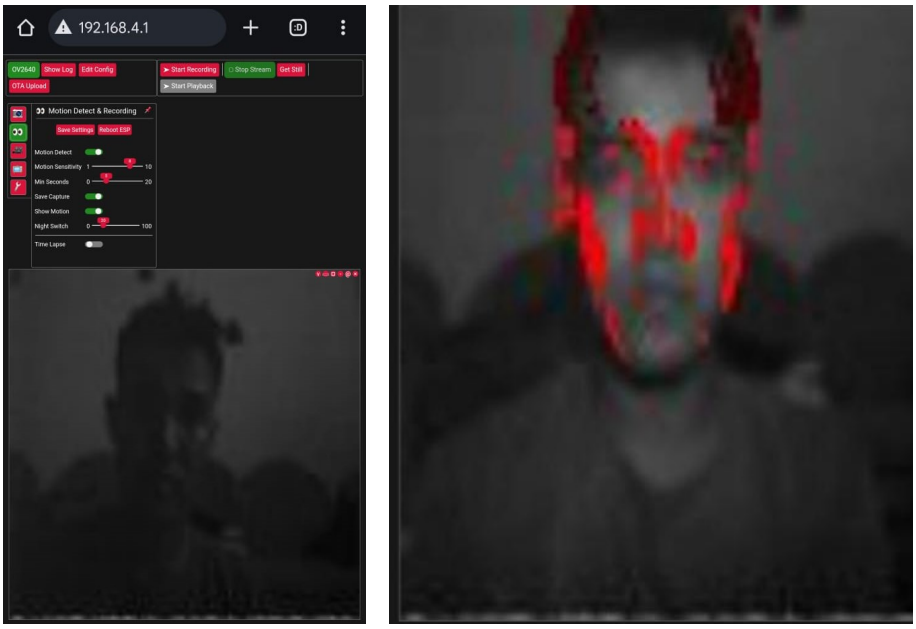

Figure 8. Motion detection test results when still and when moving

4. CONCLUSION

In the experiments that have been carried out, it can be concluded that for the entire system and its devices, the design and manufacture of a monitoring camera for violations of the use of personal protective equipment using a microcontroller and the roboflow platform can work according to the block diagram and flowchart that have been designed. In monitoring violations of Personal Protective Equipment (PPE) with a dataset consisting of 4 classification classes, namely "Person" or human, "No-Mask" or not wearing a mask, "No-Hardhat" or not wearing a helmet, and "No-Safety Vest" or not wearing a vest or project clothes. And the automatic labeling of this platform is in accordance with the actual image visualization when viewed from the normal human eye. The same is true for the second image which detects 4 classes, namely "Person" or human, "No-Mask" or not wearing a mask, "Hardhat" or wearing a helmet, and "Safety Vest" or wearing a vest or project clothes. However, in the second image, the system reads objects with the class "Hardhat" or wearing a helmet twice and does not match the actual visualization.

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