

Design of Safety Worker Helmets Based on the Internet of Things

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ABSTRACT

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Article History:

Submitted: 12-06-2024

Accepted: 15-06-2024

Published: 24-06-2024

Keywords:

Arduino Uno; GSM module;
Worker Helmets; Internet of
Things.

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Safety helmets are used to protect the head from impacts, blows, or falls of sharp and heavy objects that float or slide in the air. This helmet can also protect the head from heat radiation, fire, chemical splashes, or extreme temperatures. The main benefits and uses of a safety helmet itself are to protect the worker's head, so that it can be protected from falling objects and others, and to minimize injuries that will befall the worker himself. The use of safety helmets is very much needed by workers who work in work areas such as oil mines, factories, building construction projects, and various other things. In this study, a helmet will be designed that can be used to detect the presence of its wearer with the case title Design of Safety Worker Helmets Based on the Internet Of Things, the working system of this tool is the entire series of tools from the smart helmet system to detect the location of work accidents installed on a helmet, precisely on the inside of the helmet with the position of Arduino UNO, shock sensor, GPS module, and battery in the rear position of the helmet. For the GSM module, limit switch, and tilt sensor at the top of the helmet. The voltage source from the tool is taken directly from the battery with a voltage of 12 volts.

INTRODUCTION

Safety worker helmets are to protect the head from impacts, blows, or falls of sharp and heavy objects that float or glide through the air. This helmet can also protect the head from heat radiation, fire, chemical splashes, or extreme temperatures. Helmets or safety helmets are also in the form of body protection worn on the head and are usually made of metal or other hard materials such as kevlar, resin fibers, or plastic. Helmets are usually used as head protection for various combat activities (military), or civilian activities such as sports, and mining. Helmets can provide additional protection to parts of the head (depending on their structure) from falling or high-speed objects.

The main benefits and uses of the safety helmet itself are to protect the worker's head so that it can be protected from falling objects and others, and minimize injuries that will befall the worker himself. The use of safety helmets is very much needed by workers who work in work areas such as oil mines, factories, building construction projects, and various other things. And the use of safety helmets in work areas that are full of risks like that is mandatory because their main function is for personal protection. Because the potential for quite large risks originating from above the head often occurs in such work environments. So the existence of work safety equipment such as this project helmet is very important (Ghorpade, 2024), (Khamis et al., 2022).

Even a good safety helmet has its limits. The average lifespan of a safety helmet is 5 years, but this greatly depends on the material used to make the helmet. Each safety helmet manufacturer will list the maximum usage limit on the helmet. Check it carefully. We also need to pay attention to cleaning the safety helmet after use. This is done to avoid damage to the material due to dirt that sticks. Because the dirt could be chemicals, oil, or solvents that can trigger damage to the basic material for making the safety helmet.

From these problems, researchers will design a tool for the final project entitled "Design of Safety Worker Helmets Based on the Internet of Things, the working system of this tool is the entire series of tools from the smart helmet system to detect the location of work accidents installed on a helmet, precisely on the inside of the helmet with the position of Arduino UNO, shock sensor, GPS module, and battery in the rear position of the helmet. For the GSM module, limit switch, and tilt sensor at the top of the helmet. The voltage source from the tool is taken directly from the battery with a voltage of 12 volts.

LITERATURE REVIEW

Research that has been conducted by previous researchers using the same technology or cases in different ways, including: The helmet device is connected to a control station via the cloud using Internet of Things devices that monitor



parameters such as temperature, humidity, and toxic gases such as methane and carbon monoxide to detect any abnormalities and alert the miner via a buzzer on the helmet (Ghorpade, 2024). IoT-connected smart helmets monitor accidents for workers working hard in mines (Khamis et al., 2022). Helmet equipped with (ON/OFF) system, GPS, smoke sensor, and task completion button (Kuhar et al., 2021). IoT based Smart Helmet for Ensuring Safety in Industries (Nandhini & Priya, 2018). IoT Based Smart Helmet for Site Worker’s Safety (Popat, 2021). Internet of Things Based Helmet Security System with Tracking Features Using Android (Santoso et al., 2021). Detection of Safety Helmet-Wearing Based on the YOLO_CA Model (Wu et al., 2023). Smartguard: “An Intelligent Helmet for Enhanced Safety of Mining Work” (S.N. et al., 2023). Smart Helmet For Motorcycle Safety Based On Internet Of Things (Artiyasa et al., 2020). IoT Based Smart Helmet for Construction Workers (Jayasree & Kumari, 2022). Designing an IoT-based footstep counter for sports shoes (Aditya et al., 2023). Implementation of the Internet of Things on a Wheelchair using the MPU6050 Sensor (Maqfirah et al., 2023). Prototype of IoT-Based Fruit Alcohol Level Measurement Tool (Nursila et al., 2021).

METHOD

Analysis of system requirements

Designing a smart worker safety helmet using Arduino and GSM SIM 900A requires hardware components including: Computer, Arduino Uno, GSM SIM 900A, Limit Switch, Vibration Sensor (SW-420 vibration sensor), MPU 6050, GPS Neo 6M, Battery, Helmet, and Buzzer.

Safety Helmet With SW-420 sensor is an innovation in safety helmets which in addition to protecting the head from impact also has another function, namely a vibration detector sensor. This safety helmet will be suitable for workers who work in buildings because it can detect if there is vibration if an object falls while working. The components for the vibration detector function use Arduino as a processor and a battery for its power. The battery can be replaced with a new one when the battery runs out of power.

Tool Sketch

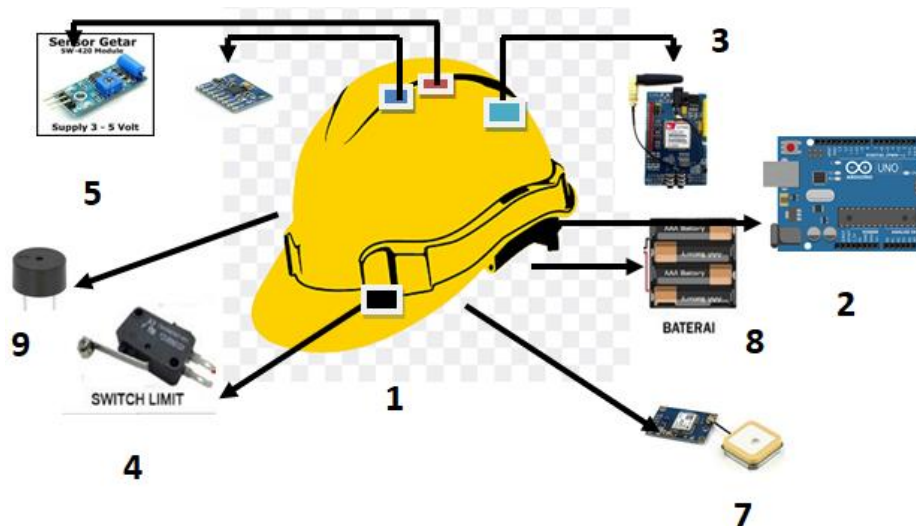


Figure 1. Tool Sketch

Description:

1. Helmet
2. Arduino Uno
3. GSM SIM 900A
4. Limit Switch
5. Vibration sensor SW-420
6. MPU 6050
7. GPS Neo 6M
8. Battery
9. Buzzer

Tool Sketch Explanation:



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1. If there is a shock or impact of an object on the helmet, the SW40 sensor will send a notification to the GSM SIM 900A
2. The GSM SIM 900A initiates the event so that the connected device is notified
3. Then the MPU6050 measures the strength of the vibration or impact, then sends a notification to
4. GPS Neo Net will notify the presence of a shock or impact on the worker's helmet

Flowchart System

The following is a flowchart of the design of how the tool works, as seen in Figure 2.

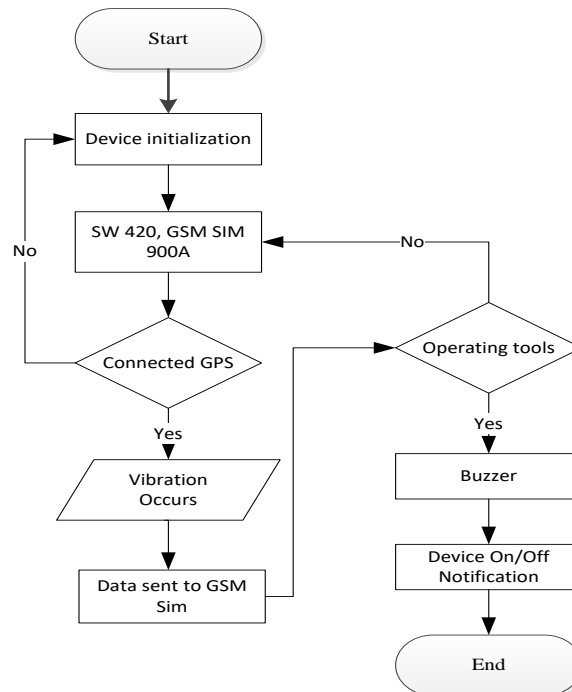


Figure 2. Flowchart System

RESULT

The results of the tool series

The entire set of components will be installed on the worker's safety helmet to control or control the entire device.



Figure 3. Overall tool set

The MPU sensor reads falls or impacts with its algorithm and then sends it to the Arduino. If the impact on the device is ≤ 1 then the sim module will send a call to the project owner's phone. If the message "location" is sent to the device then the device will reply to the Google map coordinate SMS, and the buzzer will sound after the phone and SMS come in. If you want to turn off the buzzer sound, just press the silent push button, so that the buzzer noise can be

stopped.

Tool testing results

Table 1. Drop Test

NO	Test date	Height	Response Time (seconds)			Coordinate
			Telephone	Message	Buzzer	
1	24-Jan-23	1 meter	3,2	24,2	27,4	3.336272/97.123680
2	25-Jan-23	1.5 meter	3,6	24,6	28,2	3.336177/97.123856
3	30-Jan-23	1.7 meter	3,5	24,5	28,0	3.336291/97.123680
4	02-Feb-23	2 meter	4,0	25,0	29,0	3.336301/97.123665
5	04-Feb-23	2.3 meter	3,8	24,8	28,6	3.336267/97.123756
6	07-Feb-23	2.5 meter	4,2	25,2	29,4	3.336281/97.123703

Drop Test Description:

Where in the drop test the tool was tried by jumping from a table about 1 meter, then the phone immediately rang to the owner's cellphone about 20 seconds later a message came in with the worker's coordinate location along with the sound of the buzzer. Then the test was carried out again with a drop distance of only 15 cm, but the tool could not respond to anything because the algorithm considered it a normal activity.

Table 2. Impact testing

NO	Test date	Weight of object (1 meter high)	Response Time (seconds)			Coordinate
			Telephone	Message	Buzzer	
1	24-Jan-23	2.5 ounces	-	-	-	Not in
2	25-Jan-23	5 kilograms	2,6	23,6	26,2	3.336291/97.123704
3	30-Jan-23	3 kilograms	3,0	24,0	27,0	3.336268/97.123757
4	02-Feb-23	4 kilograms	3,4	24,4	27,8	3.336302/97.123685
5	04-Feb-23	0.5 kilograms	-	-	-	Not in
6	07-Feb-23	5 kilograms	3,3	24,3	27,6	3.336274/97.123660

Impact Test Description:

Where in the impact test, an object is tried to be hit against the helmet and then hit with a heavy object weighing more than 3 kilograms, then a call comes into the owner's cellphone and after 20 seconds a message comes in with the worker's coordinate location along with the sound of the buzzer.

DISCUSSION

From the results of the Drop Test and Impact testing, the results obtained will only provide information if the fall is ≤ 1 meter and the impact force is ≥ 3 kilograms.

CONCLUSION

Based on the description of the design, manufacture, testing, and discussion of the tool "IoT-based safety helmet worker design". The following conclusions are drawn:

1. The tool works according to what has been planned in the tool design section, which consists of a safety helmet, charging module, buzzer, and IoT process.
2. GPS and SIM signals depend on the weather and obstacles such as buildings or other buildings.

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