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DESIGN OF SMART BACKPACK USING TELEGRAM APPLICATION

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Abstract: Many people use backpack because more flexible and easier to carry. Backpack can carry a lot of things. But, nowadays, lots of crimes of stolen backpack especially in public transportations or public areas. People are getting worried of their backpack and wants to have smart backpack that can protect the things they are carried. The objective of this research is to design smart backpack which consist of ultrasonic sensor, LDR sensor, GPS, buzzer and telegram application. The result of testing shows that backpack sends notification to telegram application if someone is trying to open backpack and buzzer is ringing. The location of backpack is also sent to telegram application so the owner of backpack knows the exact location of his backpack.

Index Terms – Smart Backpack, Ultrasonic Sensor, LDR Sensor, GPS, Telegram Application

I. INTRODUCTION

Backpacks are preferred over other types of bags because they are more practical, stronger and have a larger capacity than other types of bags and can share the load on both shoulders. Currently, there are many and countless backpack users, this is because the shape of the bag is easy to carry anywhere and can accommodate various objects that are needed. Backpacks are widely used when people travel to school, work and other public places, which generally means they will travel using public transportation such as trains, buses, planes and ships, or private vehicles such as motorbikes and cars. However, currently there are many crimes involving theft of backpacks. One example is the case of bag theft which has been reported in several media, namely theft at school, a teacher lost a bag which was kept in the classroom even though there were many students in the class. Furthermore, there have also been several cases of theft and items left behind on public transportation, namely the KRL, a bag containing IDR 16 million was lost along with a wallet containing a driver's license, STNK and KTP while riding the Bogor - Jakarta Kota KRL and there are many more cases of theft and lost bags that occur in the community.

Cases of bags being left behind and theft of backpacks can make backpack users worry about the equipment and valuables stored in backpacks. Therefore, many people want to have a bag that can make the items stored in it safe. This creates a feeling of calm and security when storing valuables in a backpack.

Several studies have been carried out in designing a smart bag, including those carried out by [1] to design a suitcase security system that replaces the use of a padlock. The use of fuzzy logic in the luggage security system is implemented with LDR sensors and alarms. Apart from using fuzzy logic, luggage security also uses RFID. If the suitcase is forced open by an irresponsible party without a tag attached to the RFID reader in an open space, an alarm will sound and the red LED light will turn on. If the suitcase is forced open in a closed room without a tag attached to the RFID reader, an alarm will sound and the red LED light will also light up. If the suitcase is opened with a tag attached to an RFID reader or with the same card, the suitcase will open without an alarm sounding. The RFID card used is e-KTP.

Research conducted by [2]designed a smart backpack for children that can monitor the weight of the bag, its location and provide information about the weight and location of the bag via SMS. Based on design and testing, it was found that the smart backpack can provide information about the weight of the backpack

up to ± 0.3 kg and can provide information about the whereabouts of the backpack with an average accuracy level of up to 31.72 meters. Information regarding the weight and location of the smart backpack is sent via SMS properly.

Another researcher who created a backpack security system is [3]. This research designs a security system that can detect backpacks that have been forced open and the location of the backpack using notifications on the Telegram application. If the backpack is opened by force, an alarm will sound and a notification on the Telegram application will say that the backpack was opened by force. The location of the backpack is also given on the Telegram application so that its whereabouts can be known.

Other research regarding backpack security systems was conducted by [4]. The backpack security system is made using an ultrasonic sensor to detect movement of the backpack, a PIR sensor to detect movement inside the backpack and a GPS module to determine the position of the backpack. The ultrasonic sensor is connected to an alarm and LED so that if there is movement from outside the backpack, such as the backpack being moved, the alarm will sound and the LED will light up. The PIR sensor is placed inside the backpack so that if there is movement such as someone opening the backpack, the PIR sensor will detect it and an alarm will sound. Notification of this movement is also sent to the owner via SMS. The coordinates of the bag's location are sent via SMS. If the user's smartphone has the Google Maps application, the coordinates of the bag's location can be seen through the application.

Research that has been carried out by other researchers regarding children's backpacks was carried out by [5]. The school bag designed is a smart backpack that can provide information if the backpack is overloaded. The safe limit for backpacks that can be carried by school children based on the design in this study is 10% of the child's body weight. If the load in the bag exceeds this limit, the buzzer sounds and the LCD displays the weight of the bag and the maximum weight of the backpack. Based on the results of the tests that have been carried out, the system runs well.

Research on smart backpacks was also carried out by [6]. This research designs an overload detection tool for backpacks where the maximum load capacity of the backpack is 5 kg. Smart backpacks are designed if the load of the backpack exceeds the weight of the user's mass, then the LCD will display "Overload" and a buzzer will sound. Testing of this design resulted in an accuracy rate of 99.79% with loads between 500 – 5000 grams.

Research on smart backpacks was also carried out by [7] regarding multifunctional smart backpacks for toddlers and the elderly. The smart backpack is equipped with a USB port provided to connect to a charger cable, a cooler and heater provided for storing toddler milk bottles in the backpack and relative equipment for storing more toddler equipment than parents' equipment. All the functions added to this backpack function well and can be used.

Other research that designs smart bags is research conducted by [8]. The smart bag design is made in the form of a suitcase using RFID to open and close the backpack, a GPS module connected to an SMS gateway to determine the position of the bag and a buzzer as an alarm if the bag is forced open. Based on the test results, it was found that the system can provide an alarm if the bag is forced open and the location of the bag can be provided properly via SMS.

Other research on bags is research conducted by [9]. The bag designed is a smart suitcase that is able to follow its owner and can detect obstacles around the suitcase. The system designed for this smart suitcase works well.

Based on research that has been carried out by other researcher to make backpacks or suitcases smart, as well as many cases involving forced opening or theft of backpacks or suitcases, this gives the idea to design a smart backpack where when the bag is opened a buzzer is triggered. sounds and notifications are displayed on the Telegram application. Apart from that, smart backpacks are equipped with a GPS module to send the location of the bag and display it on the Telegram application so that the owner can know the condition of the backpack.

II. RESEARCH METHODOLOGY

The design of the smart backpack was carried out based on the flow which can be seen in Figure 1.

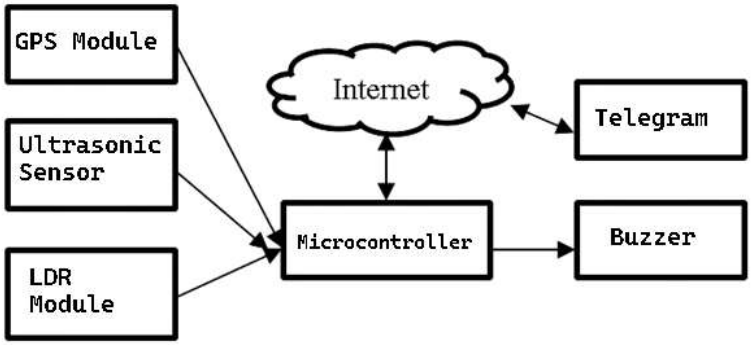

Figure 1. Design of Smart Backpack

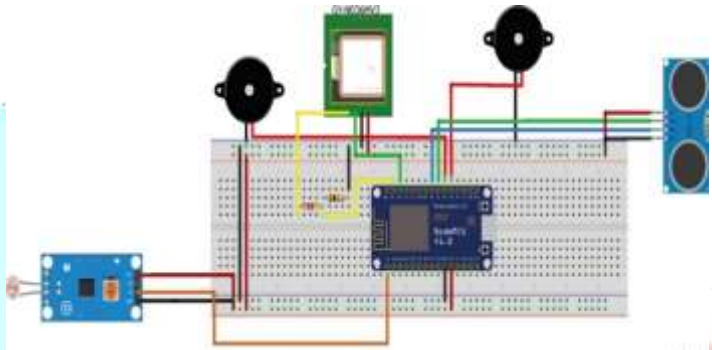

Figure 2. Circuit Component

The design of a smart backpack consists of three parts, namely the input part, the process part and the output part. The input section consists of a GPS module, ultrasonic sensor, LDR sensor and telegram application. The Telegram application used as input can activate or deactivate sensors and GPS modules. The process part is the microcontroller. The output part is the Telegram application and buzzer.

The ultrasonic sensor's role is to detect and calculate whether the distance between the bag and the ground is >=20 cm. If the distance is detected >20 cm then the sensor will send a digital signal to the microcontroller for further processing and will be forwarded to output pin D7 on the Nodemcu, which is the pin connected to the buzzer so that the buzzer pin will be HIGH and the buzzer will sound. Then the microcontroller will send a notification in the form of text "The bag has moved" via the Telegram application media interface.

The LDR sensor is a resistance value obtained from the conversion of the light intensity value entering through the bag zipper. If the resistance value read by the LDR module is <900 then the sensor will send an analog signal to pin A0 of the nodemcu. Then the microcontroller processes the input and then forwards it to the D8 output pin which is connected to the buzzer so that the buzzer pin is HIGH and the buzzer sounds. Then the microcontroller will send a notification in the form of the text "Bag has been opened" via the Telegram application media interface. The function of this sensor is to detect whether the bag is open or not.

The GPS module is in the form of a back-reflected signal from 3 or more satellites which is received by the GPS antenna (receiver), and will be calculated first to get the coordinates of the device's location which will be sent to the Telegram application. On the GPS module, the TX pin is connected to the D2 pin on the Nodemcu, which is useful for carrying out serial communication in the form of an output signal for the GPS component and an input signal for the Nodemcu which contains location coordinate information. The RX pin itself is connected to the D1 pin on the Nodemcu, which functions for serial communication in the form of an input signal. digital from Nodemcu in the form of HIGH or LOW which functions to activate or deactivate the GPS component.

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Each input signal containing measurement data from the three sensors will be checked by the Nodemcu microcontroller whether the data obtained meets the specified parameters or not. As with ultrasonic sensors, the signal reflection lag time data will be calculated to get the distance between the bag and the ground, and if the distance is >=20 cm then the results of the input will be passed on to the output of the tool.

Then for the LDR sensor, the data from the resistance measurement of the light intensity value will be checked by the microcontroller, if the parameters are met in the form of a value <900 then the input results from the LDR sensor will be forwarded to the device output. The same thing also applies to the GPS module, where once it has obtained the exact coordinates of the location of the device, the input results will be forwarded to the output in the form of a notification on the Telegram application containing the coordinates of the device's location.

The output from this tool is in the form of 2 buzzer units and a Telegram application interface. The first buzzer pin is connected to pin D7 and the second buzzer pin is connected to pin D8, if the parameters specified on the ultrasonic sensor are met then the first buzzer will sound and the device will send a notification in the form of text "The bag has moved" on the Telegram application, then if the parameters specified in The LDR sensor is fulfilled, the first buzzer will sound and the device will send a notification in the form of the text "Bag Open" on the Telegram application. The smart backpack design can be seen in figure 3.

Figure 3. Design of Smart Backpack

III. RESULT AND DISCUSSION

Testing of the smart backpack design began by testing the ultrasonic sensor with a buzzer in the bag. This test is carried out to ensure that the buzzer will sound if the ultrasonic sensor in the bag detects a change in the distance of the bag from the surface. Testing was carried out three times for each distance. The test results can be seen in table 1.

Table. 1 The Result of Ultrasonic and Buzzer Testing

Bag Distance to surface (cm)	*The Average Time of Buzzer Ringing (second)*	*Description*
30	1,35	Buzzer ringing
40	0,85	Buzzer ringing
80	1,04	Buzzer ringing
150	0,51	Buzzer ringing
>150	0,56	Buzzer ringing

The test results show that the greater the distance between the bag and the surface, the faster the buzzer will sound. The buzzer sounds with an average time of around 0.56 seconds when the distance between the bag and the surface is above 150 cm.

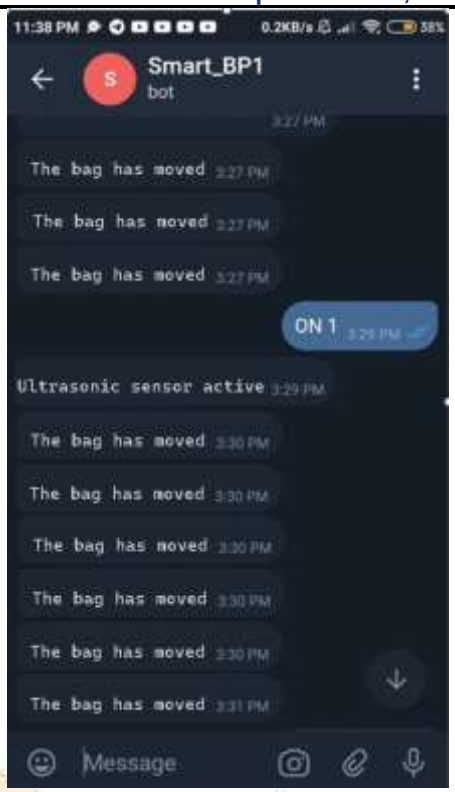

Figure 4. The Result from Telegram Application When Backpack has moved

The next test is the LDR sensor with the buzzer in the bag. This test is carried out to ensure that the buzzer sounds if the LDR sensor is active. The LDR sensor is active if the bag is open so the buzzer will give a warning. Testing is carried out indoors and outdoors.

Table 2. The Result of LDR and Buzzer Testing

Trial	***The Average Time of Buzzer Ringing in Indoor Environment When LDR active (second)***	***The Average Time of Buzzer Ringing in Outdoor Environment When LDR active (second)***	***Description***
1	0,69	0,34	Buzzer ringing
2	0,58	0,50	Buzzer ringing
3	0,52	0,43	Buzzer ringing
4	0,65	0,38	Buzzer ringing
5	0,85	0,42	Buzzer ringing

Test results show that the LDR sensor is quite sensitive when outdoors compared to when indoors. When testing the LDR sensor, a problem was found, namely that the sensor continued to read high light intensity when the bag was closed outdoors. This is because the test was carried out when it was hot outside so that sunlight could penetrate the bag when the bag was closed.

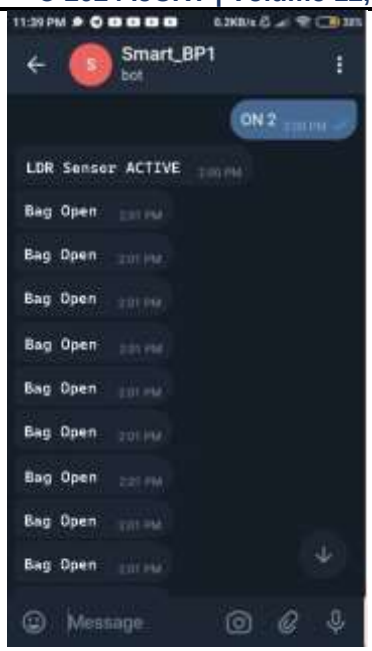

Figure 5. The Result from Telegram Application When Backpack has opened

The next test is to test the GPS module in the bag. The coordinates generated from the GPS module are sent to the Telegram application. This test aims to provide the location of the bag to the Telegram application so that if the bag has moved, its whereabouts can be known.

Table 3. The Result of GPS Modul Testing

Coordinate on GPS	***Coordinate on Telegram Application***	***Description***
-6.397477,106.809676	-6.3973741,106.8008744	2 meters difference
-6.397716,106.810669	-6.397759, 106.810613	1 meter difference
-6.399894,106.810617	-6.399894,106.810617	Accurate coordinate

The test results show that the coordinates displayed in the Telegram application are not much different from the coordinates produced by the GPS module. The appearance of the Telegram application can be seen in Figure 6.

Figure 6. The Result from Telegram Application of Backpack Location

The problem that occurs when testing the GPS module is that when the test is carried out indoors, the GPS module does not provide a very accurate position. This is shown in the test results data in table 3. When the test is carried out outdoors, the GPS module provides the appropriate position.

IV. CONCLUSION

Based on the design and test results, it was found that the smart backpack can be used as expected. Smart backpacks can provide the current position of the bag via the Telegram application. Smart backpacks can provide notifications via buzzer and Telegram application when the bag is opened and the bag moves. Even though the test results have inaccuracies regarding the location of the bag, this smart backpack can be used for everyday use. Further developments for smart backpacks can use other GPS modules and can use IoT-based applications.

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