Design and Construction of Biker Safety and Bike Security System

Khin Zaw Oo, Nu Nu Ye

Abstract— This thesis is a proposed concept for the complete safety of the biker and the security of the bike. This system makes it compulsory for the bikers to wear the helmet and not to use the bike when the biker is in drunken condition. Anti-theft measures are also implemented in the bike to ensure the safety of the bike. Biker safety and bike security system consists of two units: helmet unit and bike unit. In helmet unit, the system checks whether the biker wears the helmet and has non-alcoholic breath while driving. There is a transmitter at the helmet and the receiver at the bike. Helmet sensor switch is fitted under the chin for checking the presence of helmet and chin strap is tight or not. An alcohol sensor is placed near to the mouth of the biker in the helmet to detect the presence of alcohol. The data is transmitted through RF transmitter. The receiver at the bike receives the data through RF. The engine should not ON if any of the two conditions is violated. Arduino controls the function of relay according to data of RF receiver and thus the ignition, it controls the engine through a relay and a relay interfacing circuit. In bike unit, GSM alerts the user of the bike if any theft of the bike occurs by sending a message to the user's mobile and alarm will beep. Vibration sensor is used to detect whether bike is stolen or not, if it is parked.

Index Terms— Helmet unit, Bike unit, Helmet sensor switch, Alcohol sensor, RF transmitter, RF receiver, Arduino, Vibration sensor

1 Introduction

Transportation plays a big part of the daily lives of people because most of their daily activities takes place outside their home. The general transportation the people are using today are motor vehicles. The problems which are facing in the world are motor vehicle accidents and motor vehicle theft. Nowadays, most of the accidents are the two wheelers or the motor vehicles, which is mainly because of the decrease usage of helmets and the consumption of alcohol while driving. Several suggestions were given to reduce motor vehicle accidents and to implement antitheft measures of vehicles . Then, traffic authorities give a lot of instructions to the vehicle operators. But many of them do not obey the rules. Today, most of the countries are forcing the bikers to wear the helmet and not to use the bike when the biker is in drunken condition. But still the rules are being violated by the users. Therefore, road traffic crashes take the lives of nearly 1.3 million every year and injure 20-50 million more in the world.

For biker, helmet acts as a basic protection device. But, most of the people use traditional helmets just to prevent from challan done by traffic control police not for the safety [2]. The helmet described in this thesis is based on one single idea that is to ensure the safety of the biker as the bike will not start till the biker won't wear this helmet. Also, if the biker is drunk, then also ignition of the bike will not take place.

- *Khin Zaw Oo is currently serving in Faculty of Electronic Engineering in University of Technology(Yadanarpon cyber City), Myanmar, E-mail: zawoo.slg@gmail.com*

Today, security plays a vital role in society. The safety of vehicle is extremely essential for every private and public vehicle owner. Typically, the bikes are stolen from streets or parking lots. Bike theft indeed has become a big problem of the community. To overcome the problem, there is only the implementation of a security system in bikes. Currently, the security systems available for bike are very costly. So, the bike companies are not able to implement the security system as it increases the total cost of a bike. Therefore, it is necessary to design the security system for a bike which is less costly and easily usable for every person. The security system of the bike in this thesis is implemented for theft using vibration sensor, buzzer and GSM. If the bike is parked and someone tries to take off the bike, then immediately a SMS is sent to the owner through GSM and buzzer present in the bike will beep.

2 System Description

The block diagram of the system consists of two units: namely helmet unit and bike unit. In helmet unit, the system checks whether the biker drinks or not and the presence of helmet. If the biker fails to do any of the mentioned things above, the bike cannot be started. If the biker succeeds to do the above things, bike can be started. Wireless RF transmission is used to send data from sensor of helmet to the bike. If the bike is parked and someone tries to take off the bike, then immediately a SMS is sent to the owner's mobile through GSM and buzzer present in the bike will beep. The green block shows the ignition switch and starter of the bike.

This system uses Arduino (Nano), Arduino (UNO), push button, alcohol sensor, vibration sensor, 433MHz RF transmitter and receiver module, ignition switch, alarm, relay, battery, three buck converters and GSM module. Arduino (Nano) is used to control data from sensors of helmet. Arduino (UNO) is used to control data from sensor of bike. Push button is used to check the presence of helmet and whether the chin strap is tight or not. Alcohol sensor is used to check whether the biker drinks or not. Vibration sensor is used to detect

when someone tries to take off the bike. 433MHz RF transmitter and receiver module is used for wireless transmission between helmet and bike. Alarm is used to beep if the bike is vibrated, when the bike is parked. Relay is used to start bike. Battery is used to power Arduino. GSM is used for sending SMS to the owner.

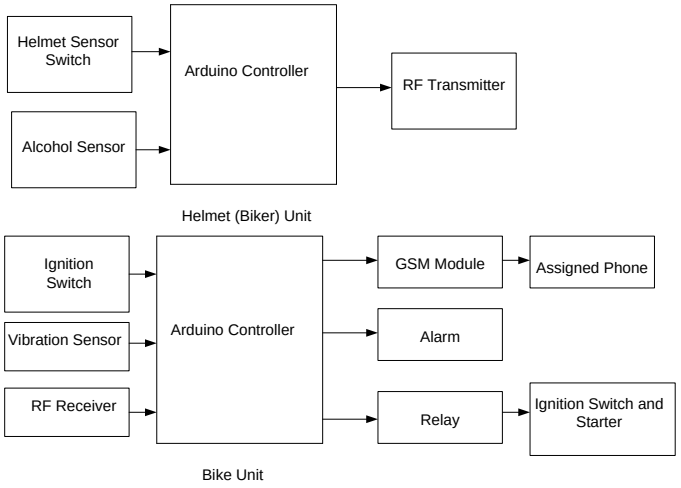


Fig. 1. Block Diagram of Overall System

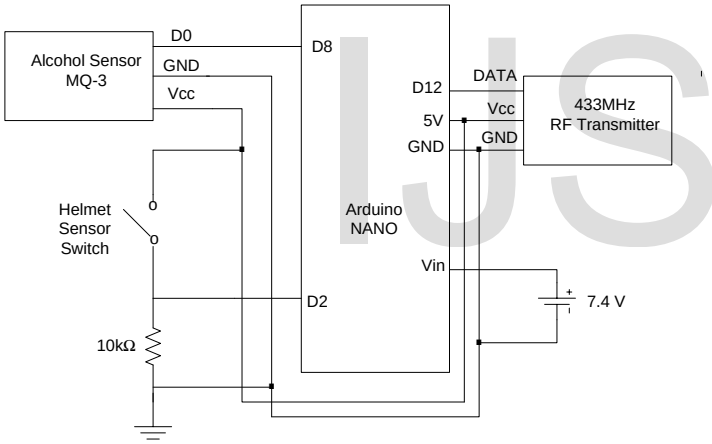


Fig. 2. Circuit Diagram of Transmitter Section

3 Design for Transmitter Section

The transmitter section consists of an alcohol sensor, helmet sensor switch (push button), Arduino (Nano) and RF transmitter. Helmet sensor switch is fitted under the chin for checking the presence of helmet and chin strap is tight or not. Alcohol sensor is placed near the mouth of the biker to detect the presence of alcohol. Arduino reads the data from helmet sensor switch and alcohol sensor. When Arduino has finished reading the data from these sensors, it gives the corresponding output to RF transmitter for transmitting the data to the RF receiver wirelessly.

3.1 Hardware Design of Transmitter Section

Fig. 2 shows the circuit diagram of transmitter section. Alcohol sensor has 4 pins. However, 3 pins are used in this circuit. These pins are digital output pin, VCC and GND.

The digital output pin of alcohol sensor is connected to the digital pin, 8 of Arduino Nano. The helmet sensor switch is connected to the digital pin 2 of Arduino Nano and 10kΩ pulldown resistor is used. 433MHz RF transmitter has 3pins. These pins are data pin, VCC and GND. The data pin of 433MHz RF transmitter is connected to the digital pin 12 of Arduino Nano. The VCC pin of all sensors and module is connected to the 5V pin of Arduino Nano. All grounds are common. The Vin pin of Arduino Nano is connected to the 7.4V battery. When the hardware design has been finished, the design for the software is developed.

3.2 Software Design of Transmitter Section

When the system starts, it firstly declares the variables required for the program. Then, Arduino Nano reads the data from the helmet sensor and alcohol sensor. If the helmet sensor is 1 and alcohol sensor is 1, RF transmitter sends char '1' to the RF receiver. If one of these sensors is 0 or both sensors are 0, RF transmitter sends char '0' to the RF receiver.

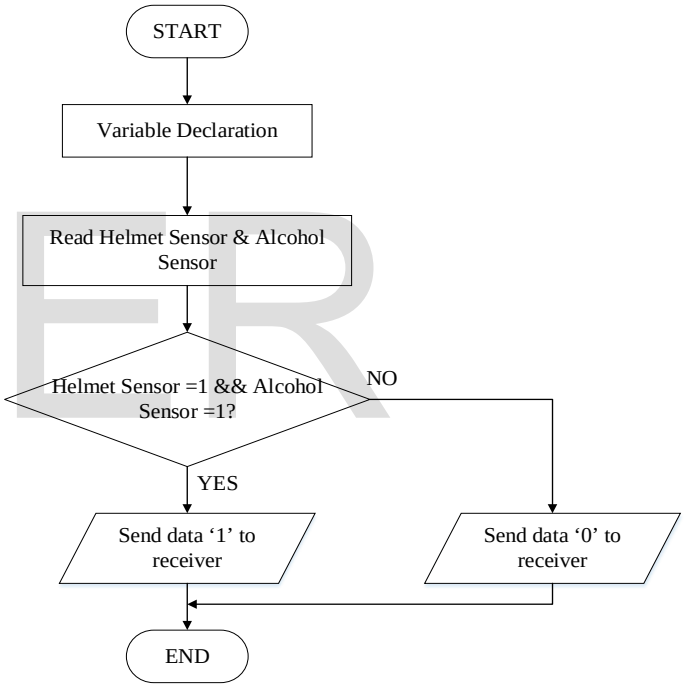


Fig. 3. Flow Chart for Transmitter Section

In this system, Virtual Wire Library is used for RF module.

#include<VirtualWire.h>

For the transmission functions, in the program, the digital pin 12 is configured as the transmitted pin. And, the speed of the data transmission is put 2kbps to begin the use of all settings and initialize the library. And then, the push to talk polarity is also configured. After that, the data is transmitted as char '1' by using RF transmitter and then the program waits for a message to be fully transmitted.

4 Design for Receiver Section

The RF receiver receives the data transmitted by the RF transmitter and give to the Arduino. According to the transmitted data, Arduino operates the ignition switch and push button starter of the bike through a relay driver circuit. When the vibration sensor detects the tilting of the bike if the bike is parked, buzzer present in the bike

will beep and immediately a SMS that "Your Bike is destroyed!" is sent to the owner by using GSM. Ignition switch checks whether the bike is parked or not. 12V battery is used to power the receiver section.

4.1 Hardware Design of Receiver Section

The data pin of 433MHz RF receiver is connected to the digital pin 11 of Arduino Uno. Ignition switch is connected to the digital pin 4 of Arduino Uno through 7805. The vibration sensor has 3 pins. These pins are digital output pin, VCC and GND. The digital output pin of vibration sensor is connected to the digital pin 3 of Arduino Uno.

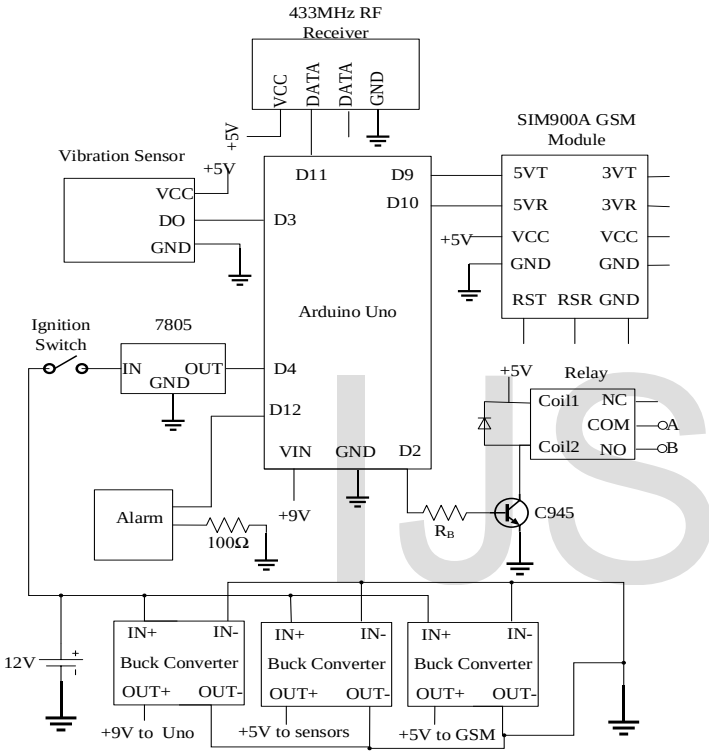


Fig. 4. Circuit Diagram of Receiver Section

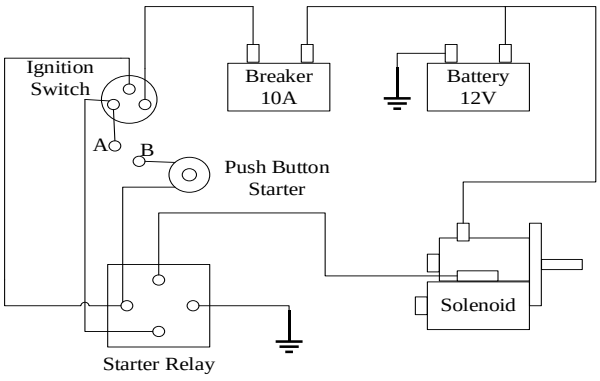


Fig. 5. Electrical System of the Bike

In the relay driver circuit, the base of C945 transistor is connected to the digital pin 2 of Arduino through R_B. A diode is placed reversed biased in parallel with the relay. The COM and NO pin of the relay is connected to the electrical system of the bike is shown in Fig. 5. SIM900A GSM module has 11 pins. However, 4 pins are used in this circuit. These pins are TX, RX, VCC and GND. Transmit pin (TX) and receive pin (RX) is connected to the digital pins 9, 10 of the Arduino Uno. Because these pins 9, 10 are assigned by Software Serial pins in library. After the hardware design is finished, the design for the software design is developed.

4.1 Software Design of Receiver Section

When the program is started, it declares variables and Arduino Uno reads the data from ignition switch and vibration sensor. Then, 433 MHz RF receiver checks whether data is reached from the transmitter. If data is reached, RF receiver checks whether reached data is equal to 1. If it is true, relay is energized. If reached data is not equal to 1, relay is de-energized. If the data is not reached from the transmitter, check whether ignition switch is 0 and vibration sensor is 1. If it is true, Arduino sends a SMS "Your Bike is destroyed!" to assigned phone via GSM and then alarm beeps for 30 seconds. And then, go to connector 1. Then, recheck whether ignition switch is 0 and vibration sensor is 1. If it is false, alarm does not beep and then go to connector 2 and the system repeats.

For SIM900A GSM module, SoftwareSerial Library is used in this thesis because the digital pins 9 and 10 of the Arduino is connected to the TX and RX pin of GSM module. Software Serial is a library of Arduino which enables data communication through other digital pins of Arduino. If the TX pin of GSM module is connected to the RX pin of Arduino and the RX pin of GSM module is connected to the TX pin of Arduino, library is not required. But, in this thesis, SoftwareSerial Library is used for SIM900A GSM module.

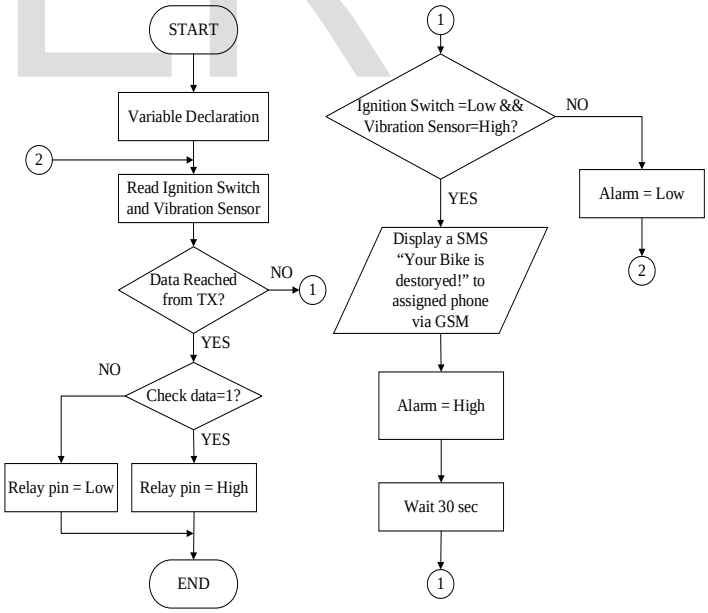


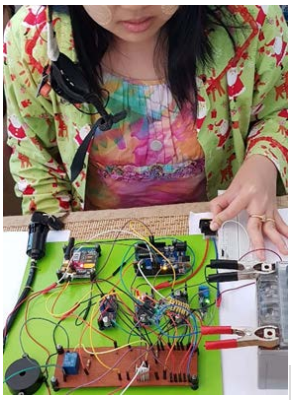
Fig. 6. Flow Chart for Receiver Section

5 Tests and Results

Fig. 7 shows the testing of biker safety system. When the ignition switch is on and push button starter is pressed, LED is off because the chin strap is not tight, as shown in Fig. 7 (a). Fig. 7 (b) describes the testing of chin strap is tight and alcohol is not drunk. In

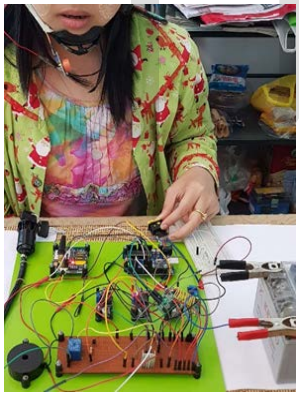
this condition, if the ignition switch is on and push button starter is pressed, LED is on, as shown in Fig. 7 (b) and then, the current flows through the stepper motor of the bike in practical. Fig.7 (c) illustrates the testing of chin strap is tight and alcohol is drunk. In this condition, the ignition switch is on and then, when push button starter is pressed, LED is off, as shown in Fig. 7 (c).

Fig. 8 shows the testing of bike security system. In Fig. 8 (a), while the ignition switch is on, alarm does not beep and SMS is not sent, even if the vibration occurs. When the ignition switch is off, if the vibration occurs, alarm beeps and SMS is sent to assigned phone. This result is shown in Fig. 8 (b).



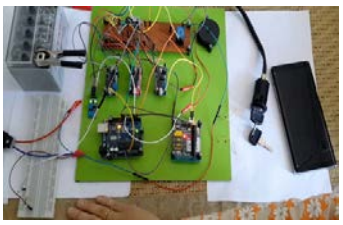
(a) Chin Strap is not tight

(b) Chin Strap is tight

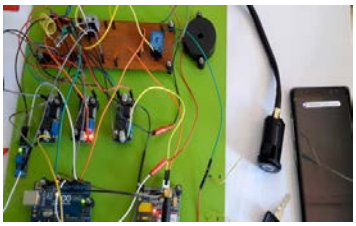


(c) Chin Strap is tight but Alcohol is drunk

Fig. 7. Testing of Biker Safety System



(a) No Sending SMS



(b) Sending SMS

Fig. 8. Testing of Bike Security System

6 Conclusion

In this system, the alcohol senor is used for alcohol detection. Alcohol sensor can sense alcohol only during the distance (2 inches). If this distance is over, it cannot sense. The 433MHz RF module is used for wireless communication in this system. This module limits the range of coverage area up to 100 meters in open space. SW-420 vibration sensor detects not only vibration but also tilting. 18650 li-ion battery is used to provide the power to Arduino and sensors from helmet. The battery life time of 18650 li-ion battery is 8 hours according to the calculation from the current usage of transmitter circuit. Relay used in this thesis is the contact capacity of 10A 28V DC.

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