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DESIGN AN AUTOMATIC BELL BASED ON ARDUINO UNO AT STATE VOCATIONAL SCHOOL 5 SERANG CITY

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Abstract (English)
School bells that use electricity produce a buzzer sound or a series of tones on the bell machine that change every time during class, recess or after school. By utilizing Arduino microcontroller technology, the school bell can automatically start ringing according to the clock settings. With this technology, school bells can be controlled at certain times according to a schedule and turn on automatically. With an Arduino-based sound output, all the information produced can be easily understood. This research uses the SDLC (System Development Life Cycle) method, which is a general methodology in system development that marks the progress of analysis and design efforts by dividing 2 types of systems, namely hardware systems and software systems. because the electronic system (hardware) is able to provide automatic notification sound output with economical electricity consumption and a sound frequency that is clearly audible when tested according to the time of teaching and learning activities at school. Makes it easier to ring/activate the school bell, because the school bell is automatically included in the school bell. So the school bell rings automatically according to the schedule that has been entered (software).

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School bell, Prototype,Arduino, SDLC
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INTRODUCTION

A school is a formal and non-formal educational unit organized by the state or private sector with the main aim of providing teaching, managing and educating the nation's generation to become the desired human resources.

In the world of education, time is a very crucial aspect. Every second has valuable value in the student learning process. In an effort to create an efficient and orderly learning environment, the role of the school bell system is very important. The school bell system is not just a tool to announce the change of class hours, but is also the foundation that supports the entire dynamics of the teaching and learning process. Learning activities at the school where the author's research is conducted start at 07.00 when entering class, at 10.10 for the first break, at 12.00 for the second break and at 15.40 the students leave class.

With an automatic school bell system, not only can regular timings be maintained, but also the quality of students' learning experience can be improved. Students and teachers can focus completely on the learning material without distractions or disturbances related to time management. In addition, the use of an automatic bell system also reflects technological advances in the world of education, providing a positive impact on the overall operational efficiency of schools.

Computerized technology is currently very much needed by every agency or institution. Therefore, educational institutions and other institutions are competing to integrate computer technology to accelerate institutional performance and empower human resources who have knowledge and are ready to compete in the era of digitalization.

The development of hardware and software today has a big influence on the use of computers in various aspects of the field. Computers which were initially only used by academics and the military have now been used in various fields. For example in the fields of health, offices, education, publications

Every school has the supporting facilities and infrastructure needed for the effectiveness of the teaching and learning process. Lack of facilities and infrastructure becomes a problem for students in the learning process and they are unable to develop interests and talents in certain fields. The impact is the low quality of educational output which is only oriented towards book learning resources. There are many components that support the continuity of the learning process in schools, such as educational objectives, students, educators, learning materials, approaches or methods, media or tools, learning resources and evaluation.

In this context, the development of an Arduino-based automatic bell becomes relevant because it provides the potential to improve system performance, flexibility and efficiency. Arduino is a hardware development platform that is relatively affordable, easy to use, and has a wide selection of sensors and actuators that can be integrated.

By leveraging the Arduino uno's capabilities, an automatic doorbell can be implemented more easily, even by those with limited knowledge of programming and electronics.
Apart from that, automatic bells also have a number of practical benefits, including:

1. Reduces dependence on manual operation: With automatic bells, there is no longer a need for someone to manually set or press a button to activate the bell. This reduces human error and frees up labor for more valuable tasks.
2. Improves precision and response time: Automated systems are able to respond to events quickly and accurately, ensuring the bell rings at the specified time without delay.

Flexibility in settings: By using digital technology, automatic bell settings and adjustments can be made more easily and quickly, according to needs and changing situations.

THEORETICAL BASIS

Planning

Design is the process, method, or act of designing. The specified design becomes the system design. According to several experts, system design is the stage after analysis of the system development cycle as well as preparation for design or describing how a system is formed (Verzello / John Reuter III).

Another definition states that design or system design is the depiction, planning and sketching or arrangement of several separate elements into one complete and functioning unit (John Buch and Gary Grudnitski). According to Susanto (2004:332) explains that "design is a general and detailed specification of computer-based problem solving that has been selected during the analysis stage". In system development, the design stage is the most important stage, where at the design stage there will be identification of what problems will be used as design material, so that a good information system can be produced.

Prototype

A prototype is a system or design that is an example or standard of the object to be worked on. Prototyping is an approach method in system development by creating a program quickly and gradually so that it can be directly evaluated by users. The prototype provides an overview to users regarding the system that will be developed. In other words, a prototype is an initial demonstration of a software that explains the concept and appearance.

Automatic School Bell

Bells, chimes or bells are simple equipment used to create sound. The shape of a tube with one side that opens and resonates when struck. The tools for hitting are in the form of a long bat that is hung inside the bell or a separate bat. According to the KBBI, a bell has two meanings, the first is that a bell is a kind of bell that is rung to determine the time or notify something, while the second meaning is that a bell is a large clock or watch. Large bells are generally made of metal, but small bells can also be made of ceramic or porcelain.

Current developments in science and technology have influenced the convenience of tools in everyday life. School bells now use electricity to produce a sound or a series of tones on the school bell machine. Apart from keeping up with developments, the school bell application is practical because it is easy to run automatically. Errors in the sound provide uncertain information regarding schedules or clock changes.

With an Arduino-based automatic school bell application which is equipped with sound output, all information produced by the bell machine can be easily understood.

RESEARCH METHODS

In this research, the researcher took place for her research at SMKN 5 Serang City starting from May – August 2024, the researcher used qualitative research. Qualitative research, namely research produces findings that cannot be achieved by statistical calculation procedures from quantification (measurement). The method used is the waterfall method, namely the SDLC (System Development Life Cycle) process, which is the first SDLC method in software development. Classic methodology used to develop, maintain and use information systems. The system life cycle itself is a methodology, but the pattern is more influenced by the need to develop a faster system by dividing 2 types of systems, namely hardware systems and software systems. in system development where requirements are transformed into a working system which is continuously improved through collaboration between users and analysis.

The waterfall method is a software development method that prioritizes a linear and structured sequence of stages, from analysis to design, implementation, testing and maintenance. Here are the general steps:

1. Analysis

   At this stage, you need to analyze the need for an automatic bell. Determine clearly what you want to achieve with this automatic bell. For example, should the bell ring at a certain time, or when there is movement, or perhaps use a button to activate?

2. System Design

After determining the needs, the next step is to design an automatic bell system. This includes selecting hardware components (such as motion sensors, buttons, speakers), as well as designing the software that will be used to control the Arduino Uno.

3. Implementation

   At this stage, the researcher will begin to implement the design that the researcher has created. Perform the following steps:

   - Prepare the Arduino Uno and connect the components.
   - Write program code using the Arduino IDE.
   - Be sure to test each component separately and together to ensure everything is working as expected

4. Testing

   After implementing the program code, perform thorough testing of the automatic bell. Test various scenarios such as:

   - Buzzer response testing.
   - Bell reliability testing.
   - Be sure to identify and fix any bugs or issues that may arise during testing.

5. Verification

   After carrying out the next test, we verify whether the system that has been created is running well or not.

6. Maintenance

After successful testing, you should consider the care and maintenance of this automatic bell system. This includes ensuring that the hardware is functioning properly, and if necessary, updating or repairing program code to improve functionality or address problems as they arise.

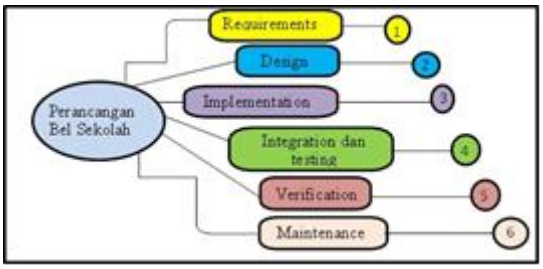

Figure 1. School Bell Design (Waterfall Method)

Design Tools and Materials

In this research, the researcher chose to use descriptive analysis techniques where in the presentation he used a list of hardware and software components. The following is the list components, both hardware and software required in based automatic bell design Arduino.

Table 1. Tools and materials

Hadware	**Software**	**Supporting**
Arduino board is data processor	Windows 10 is an application that is used on computer devices or PCs. Nor laptops	Tripleks or other samiliars
Buzzer / Speaker as a sign or sound	Arduin o IDE is software that is programmed to carry out commands and syntax functions in certain programs	Glue Gun
RTC DS3231 for giving time	Fritzing is a software tool to create simulations (images) of circuits the electronics	Multi meter/ Avometer

Cables act as a connection between each component	The library (additional) is a software for making electronic circuits in the Fritzing software. It doesn't exist yet, so we need to look for it. the library again	Soldering
The USB cable is used as an interface between the Arduino Uno R3 and computer programming or communication or laptop		Tin
PCB to make electrical connections between components RTC		
Bluetooth is a Bluetooth SPP (Serial Port protocol) module that is easy to use for wireless serial communications (wireless)		
DF Player is an MP3 module that can be directly connected to speakers		
A resistor is a device that provides a barrier to the flow of voltage Electricity		
A relay is an electrically operated switch that can be turned on or off turned off		
16x2 LCD		

is a liquid crystal display. The working principle of an LCD is to regulate the available light, or LED lights up		
I2C is a system LCD display		
Push Button is an electronic component that can interrupt and flow electric current in an Arduino project circuit		
RCA connector whose function is to connect the jack audio		
A laptop is a device used to help complete reports thesis		

Research Flow Process

In this research, there are several stages or steps that researchers will carry out, starting from the model planning stage to the final research results. The stages carried out are as follows:

1.Planning Stage

This stage is the initial stage in designing a tool in the form of a prototype, namely an automatic school bell to control the Arduino-based school schedule which includes preparing the tools and materials that will be used.

2. Designing an automatic school bell. After the equipment process is adequate, then carry out a circuit and program which will be made in the form of a physical circuit and create a program on the computer to be entered into the Arduino so that the device can be controlled with the Arduino.

3. Automatic School Bell Testing

After completing the activities of assembling and programming the Arduino, then the prototype will be run using the Arduino Uno. After that, you will see the results of the automatic school bell that has been tested, whether it works as expected or not.

Prototyping

Prototyping is the process of creating a model or initial version of a product, system, or concept with the aim of testing, evaluating, and developing. This is the final product chain step.

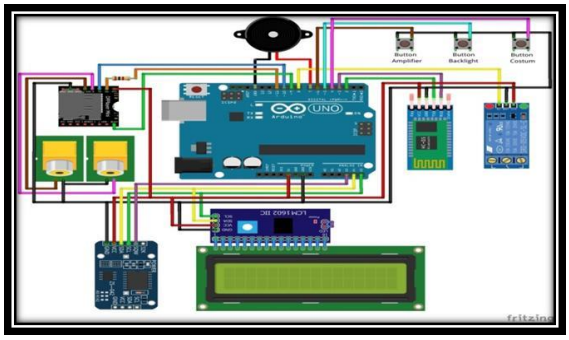

Figure 2 Prototyping sequence

Automatic Bell Design

In designing the UML (Unified Modeling Language) of an Arduino Uno-based automatic school bell system, we can use several diagrams that cover various aspects of the system. The following is a UML diagram that can be created in this system:

1. Usecase Diagram

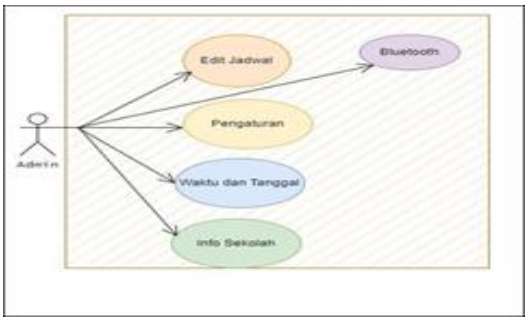

Figure 3. Use case Diagram

2. Activity Diagram

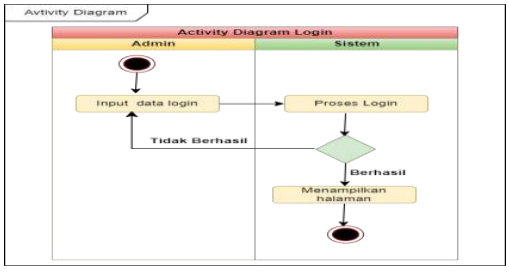

Figure 4. Activity Diagram Login

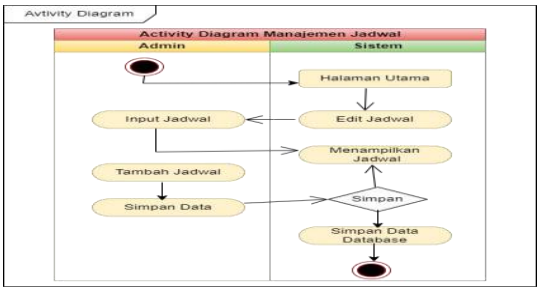

Figure 5. Schedule Management Activity Diagram

3. Sequence Diagram

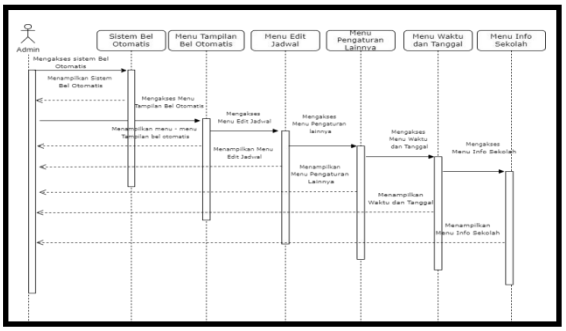

Figure 6. Squence Diagram Bel Sekolah

4. Class Diagram

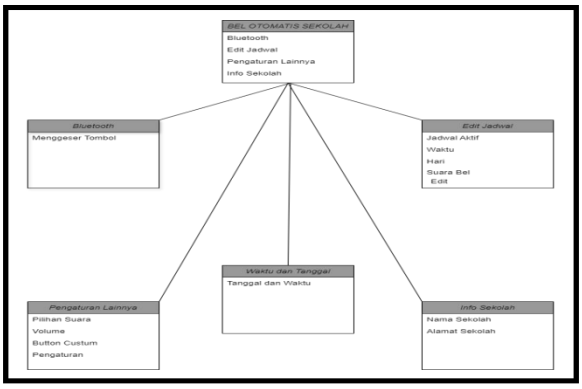

Figure 7. Class Diagram Bel Sekolah

System Analysis

a. Running system

The ongoing system analysis aims to find out more clearly how the system works and the problems faced by the system so that it can be used as a basis for a proposed design for the ongoing system analysis which is carried out based on the existing sequence of events and from the sequence of events a diagram can be created, from there The author conducted interviews, discussions and observations with the deputy head of the curriculum section who manages the lesson schedule and the deputy head of the facilities and infrastructure section.

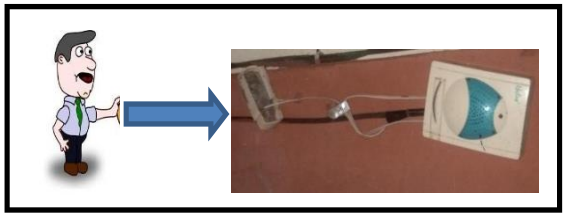

Figure 8. Manual bell

The system that runs regarding school bells can be described in a Usecase Diagram. The current system use case diagram is as follows:

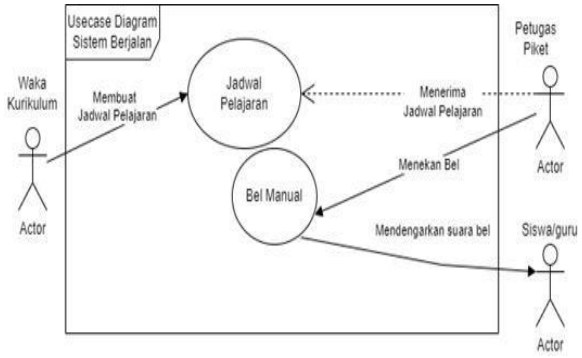

Figure 9. Usecase Diagram of the running system

b. Proposed system

System analysis is the decomposition of a complete system into its component parts with the aim of identifying and evaluating problems. This analysis section consists of problem analysis, needs analysis, and weakness analysis.

1. Problem Analysis

Based on the analysis of the current system, it can be seen that when class time starts and class time changes or school leaving time, sometimes the bell attendant or teacher forgets to ring the bell according to the specified schedule so that the teaching and learning process becomes ineffective and inefficient due to the interruption of the scheduled class time. scheduled. From the problem analysis, an automatic school bell system can be proposed, where with this system the bell will ring automatically according to the time of the predetermined schedule. So that it can make the work of teachers or teaching staff more efficient and the teaching and learning process will be more effective without the disruption of class hours being cut

2. System Requirements Analysis

a. Interface Requirements (Interface)
b. Data Requirements
c. Functional Requirements

3. Weakness Analysis

Automatic school bells make it possible for picket officers to make necessary schedule changes, because these automatic bells are only for teaching and learning activities as usual, not for changing hours for exams or exams.

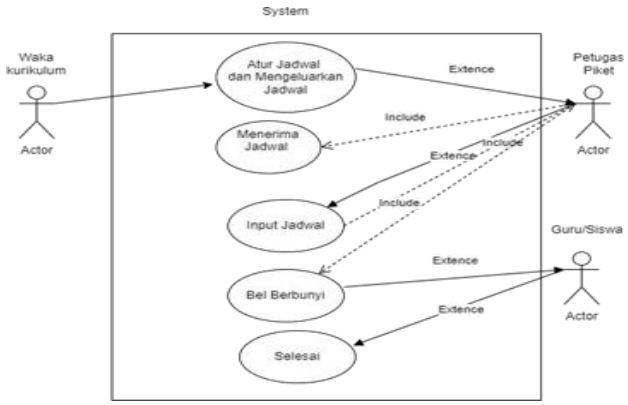

Figure 10. Usecase Diagram of the proposed system

RESULTS AND DISCUSSION OF SYSTEM IMPLEMENTATION

System implementation is the stage of carrying out a newly developed system so that the system is ready to operate as expected. The purpose of this implementation stage is to prepare all activities related to the system that has been created and designed.

Design of the RTC (Real Time Clock) Module

The Real Time Clock (RTC) DS3231 used in this research will function as the proposed automatic school bell timer. DS3231 RTC circuit with Arduino can be seen in the picture as follows:

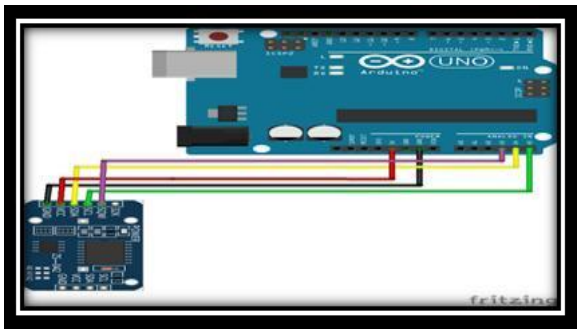

Figure 11. . DS3231 RTC circuit with Arduino

Table 2. Real Time Clock Module Circuit (RTC)

RTC DS3231	ARDUINO UNO
VCC	Pin 5V
GND	GND
SDA Serial Data pin(I2C interface)	Pin A4
SCL Serial Clock pin(I2C interface)	Pin A5
SQW Square Wave output pin	Pin A3

Radio Corporation of America (RCA) Connector Design

The Radio Corporation of America (RCA) connector used in this research is the RCA Lumberg type which functions as a connector for the jack audio cable to sound or speakers.

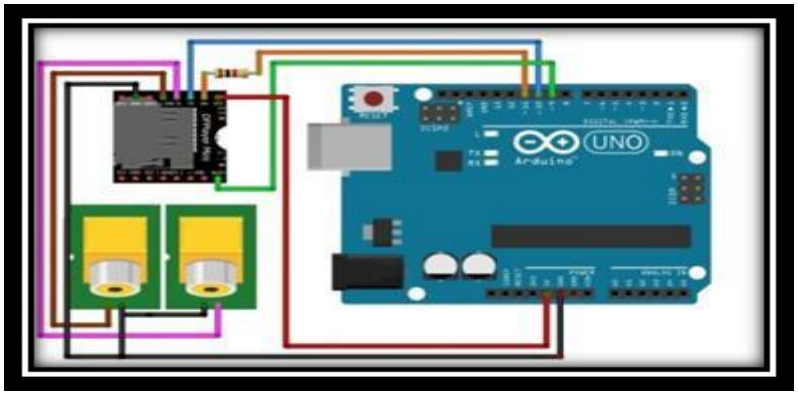

Figure 12. RCA connector circuit, DF Player, Resistor and Arduino Uno

Table 3. RCA connector connection, DF Player, Resistor with Arduino

KONEKTOR RCA	DF PLAYER	RESISTOR	ARDUINO UNO
GND	GND	-	GND
R	R	-	-
L	L	-	-
-	TX	-	Pin 10
-	RX	(+ ke DfPlayer; - ke Arduino)	Pin 11

Bluetooth module with Arduino Uno

Bluetooth HC-05 is an easy-to-use Bluetooth SPP (Serial Port Protocol) module for wireless serial communications that converts a serial port to Bluetooth. HC-05 uses Bluetooth V2.0 + EDR (Enhanced Data Rate) 3 Mbps modulation by utilizing 2.4 GHz frequency radio waves. This module can be used as a slave or master.

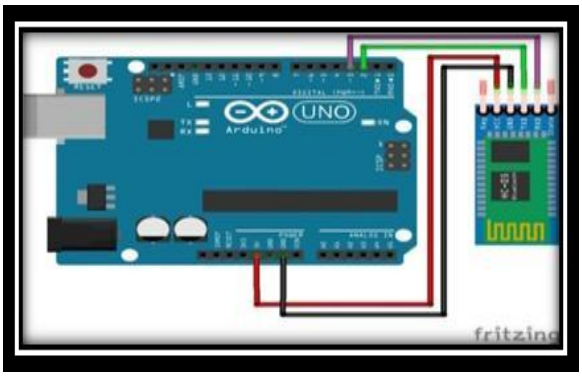

Figure 13. Bluetooth Module Circuit HC-05

Table 4. HC-05 Bluetooth Module Connection with Arduino Uno

BLUETOOTHHC 05	ARDUINO UNO
VCC (*VoltageCommon Collector*)	Pin 5V
GND (*Ground*)	GND
TxD (SaluranKirim)	Pin 2
RxD (SaluranTerima)	Pin 3

LCD + I2C module with Arduino Uno

LCD (Liquid Crystal Display) is a liquid crystal display. The working principle of the LCD is to regulate the existing light, or LED flame, while the I2C / TWI LCD2004 module is a display system using a 16X2 dot matrix LCD. The LCD + I2C Module Design with Arduino Uno is as follows:

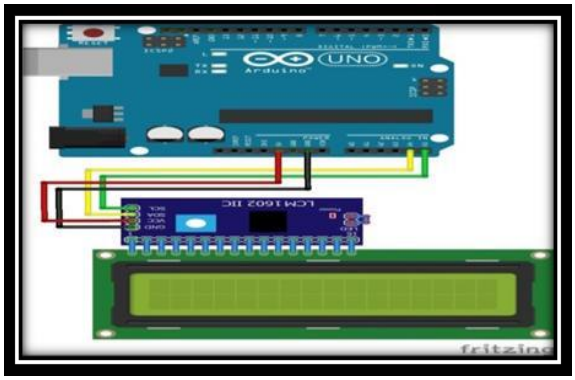

Figure 14. LCD + I2C Module Circuit with Arduino Uno

Table. 5 LCD + I2C Module connections with Arduino Uno

LCD + I2C	ARDUINO UNO
VCC	Pin 5V
GND	GND
SDA Serial Data pin (I2C interface)	Pin A4
SCL Serial Clock pin (I2C interface)	Pin A5

After the author designs several components into a device, namely an automatic bell, he continues with programming using the Arduino IDE software. As for the programming, I will show several

```
#include <avr/sleep.h> #include <Wire.h> #include <AceButton.h>
#include <LiquidCrystal_I2C.h>#include "RTC.h"
#include <EEPROM.h> #include "SoftwareSerial.h"
#include "DFRobotDFPlayerMini.h"#include "name_of_struct.h"
using namespace ace_button;#define btn_ampli 6
#define btn_backlight 5
#define btn_costum 4
#define buzzer 7
#define pinRelay 8 #define SQWPin A3 #define
relayOn HIGH #define tokenEEPROM 0x47
#define namaSekolah "Nama Sekolah" SoftwareSerial
mySoftwareSerial(10,11);
SoftwareSerial bluetooth(2,3);
DFRobotDFPlayerMini myDFPlayer; LiquidCrystal_I2C lcd(0x27, 16, 2); RTC_DS3231
rtc;
DateTime now;
AceButton button1(btn_ampli); AceButton button2(btn_backlight);AceButton
button3(btn_costum);
void button_event(AceButton*, uint8_t,uint8_t);
char namaHari[][7] = {"Minggu", "Senin","Selasa", "Rabu", "Kamis", "Jum'at", "Sabtu"};
char bufWaktu[40];
byte indexMataPelajaran;
byte indexPengaturanJadwal = 0;byte detikSebelumnya = 60;
byte tanggalSebelumnya = 0;byte menitBel;
byte jadwalBerikutnyaKegiatan; void setup() { Serial.begin(9600);
mySoftwareSerial.begin(9600); bluetooth.begin(9600); mySoftwareSerial.listen(); Wire.begin();
Wire.beginTransmission(0x3F); if (Wire.endTransmission())
```

```
{
 lcd = LiquidCrystal_I2C(0x27, 16, 2);
}
 lcd.begin();
 rtc.begin(); rtc.writeSqwPinMode(DS3231_SquareWave1Hz);
ButtonConfig*buttonConfig    =
ButtonConfig::getSystemButtonConfig();
 buttonConfig-
>setEventHandler(button_event);
 buttonConfig-
>setFeature(ButtonConfig::kFeatureClick);
 buttonConfig-
>setFeature(ButtonConfig::kFeatureDoubleClick);
  buttonConfig-
 >setFeature(ButtonConfig::kFeatureLongPress);
  buttonConfig-
 >setFeature(ButtonConfig::kFeatureRepeatPress);
  lcd.command (0x40 | (0 << 3));for (byte i = 0; i < 8; i++) lcd.write (karakterDetik1[i]);
  cek_error();
  default_settings(); lcd.backlight(); lcd.setCursor(0, 0);
  lcd.print(F("SMKN 5 KOTSER"));
  lcd.setCursor(0, 1); lcd.print("By: Ali Mabruri");delay(2000);
  lcd.clear();delay(50);
 }
 void loop() { button1.check();button2.check();button3.check();
  if (ver_lib_dfplayer) {
if (myDFPlayer.available()) { printDetail(myDFPlayer.readType(),
myDFPlayer.read());
   }
  }
 if (isPlaying) {
   if (play_bell == true) {play_bell = false; data_play = 0;
    myDFPlayer.play(jadwalBerikutnyaKegiatan + 2);
     ms_relay = millis();
     if (repeat == 1 && count_repeat == 0) {index_2 = true;
     }
     else {
      index_2 = false;
     }
   }
   if (digitalRead(SQWPin)) {if (rtcValid) {rtcValid = false; now = rtc.now();
uint16_t unixJadwalBerikutnya =(jadwalBerikutnya.jam      60)      +
jadwalBerikutnya.menit;
       uint16_t unixWaktu = (now.jam * 60) + now.menit;
            if (jadwalBerikutnyaKegiatan &&(unixWaktu == unixJadwalBerikutnya - 1)) {
statusPengingat = true;
}
else {
     statusPengingat = false;
    }
```

Assembly Results

With the equipment, supplies and materials that have been prepared, the assembly or design results can be successfully carried out. The assembly results are in the image below

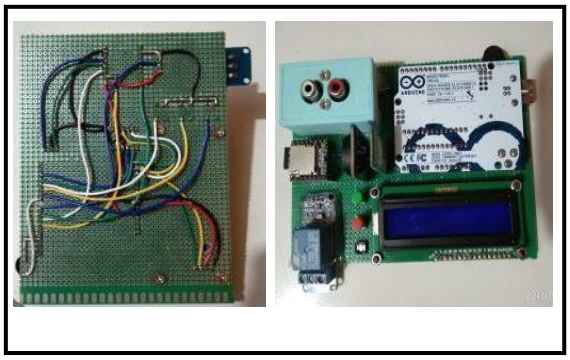

Figure 15. Assembly results

Testing process

In the Arduino Uno-based automatic bell testing process, it is carried out to ensure that the project is successful or not.

Testing the Class Hours Indicator System, automatically created to allow resetting of RTC times and class schedules directly using Bluetooth without the need to re-upload the program using a laptop

Table 6. Data entered with bluetooth

Schedule edit menu

	Jadwal aktif	Waktu	Hari	Suara	Edit
☐	Jadwal 1	07:00	010000	Upacara	
☐	Jadwal 2	08.10	010000	Jam 1	
☐	Jadwal 3	08.50	010000	Jam 2	
☐	Jadwal 4	09.30	010000	Jam 3	
☐	Jadwal 5	10.10	010000	Istirahat	
☐	Jadwal 6	10.40	010000	Jam 4	
☐	Jadwal 7	11.20	010000	Jam 5	
☐	Jadwal 8	12.00	010000	Istirahat	
☐	Jadwal 9	13.00	010000	Jam 6	
☐	Jadwal 10	13.40	010000	Jam 7	
☐	Jadwal 11	14.20	010000	Jam 8	
☐	Jadwal 12	15.00	010000	Jam 9	
☐	Jadwal 13	15.40	010000	Pulang	

In the table below, the schedule for automatic bell ringing is explained from the time of starting the first lesson until the end of school.

Table 7. System Testing on School Days

HARI	WAKTU										
SENIN	0700	08.10	08.50	09.30	ISTIRAHAT PERTAMA (10:10)	10.40	11.20	ISTIRAHAT KEDUA (12:00)	13.00	13.40	14.20	15.00
	√	√	√	√		√	√		√	√	√	√
SELASA	07.30	08.10	08.50	09.30		10.40	11.20		13.00	13.40	14.20	15.00
	√	√	√	√		√	√		√	√	√	√
RABU	07.30	08.10	08.50	09.30		10.40	11.20		13.00	13.40	14.20	15.00
	√	√	√	√		√	√		√	√	√	√
KAMIS	07.30	08.10	08.50	09.30		10.40	11.20		13.00	13.40	14.20	15.00
	√	√	√	√		√	√		√	√	√	√
JUM'AT	07.30	08.10	08.50	09.30		10.40	11.20		13.00	13.40	14.20	15.00
	√	√	√	√		√	√		√	√	√	√

√ a sign that the sound is on/out.
x sign if the sound does not turn on/come out.
Menu Display - Mmenu
1. Main Menu Display

Figure 16. Main Menu

The main menu is the menu used to display the desired menu options or to enter the desired menu.
2. Edit Schedule display

Figure 17. Edit Schedule Menu

This menu is used to edit or write the time, day selection and bell sound.

3. Time and Date Display

Figure 18. Time and Date menu

This menu displays the current time and date

4. Display Other settings

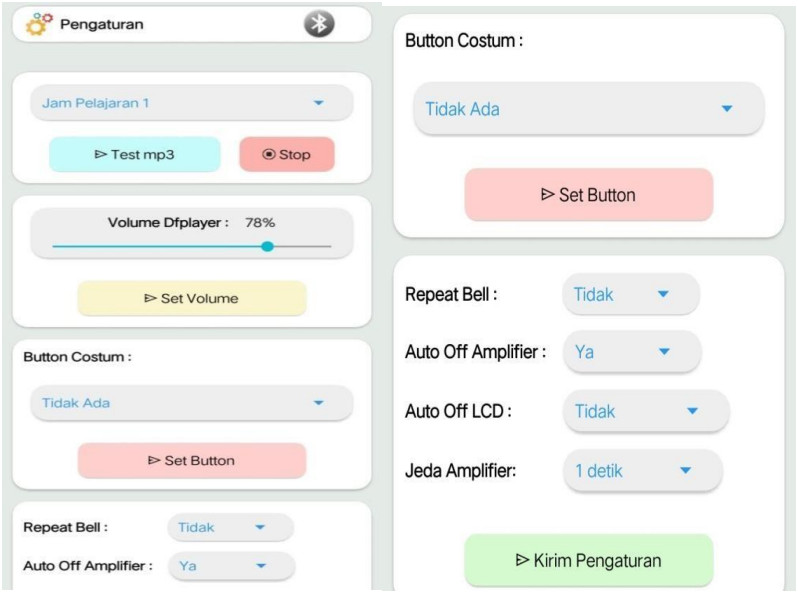

Figure 19. Other settings menu

This menu displays settings for testing how big the desired sound volume is, buzzer repetition, amplifier auto off settings, LCD auto off settings and amplifier pause.

5. Display school info

Figure 20 Info Display Menu

This menu displays filling in the school identity

CONCLUSION

Based on the results of assembling, designing and testing the Arduino Uno-based school bell, it can be concluded that this tool can answer the research objectives. In essence, this research aims to make the task of pickets easier in order to ensure smooth teaching and learning activities. The duty of the picket here is only to receive guests, while the bell will automatically ring or be issued according to the time that has been input.

In essence, this research aims to make the task of pickets easier in order to ensure smooth teaching and learning activities. The duty of the picket here is only to receive guests, while the bell will automatically ring or be issued according to the time that has been input. The method used is the waterfall method, namely the SDLC (System Development Life Cycle) process which is intended to build, maintain and use information from the Requirements gathering and analysis, Design, Implementation, Integration & testing, Verification, Operation & maintenance stages, the development of this method can produce tools that suitable for use in the form of an automatic school bell.

SUGGESTION

Based on the results, there are several suggestions that can be written for further development and research.

1. It is necessary to develop the "automatic school bell" function so that it can be marketed and patented in line with current developments.
2. It needs to be tested directly by the school in order to get a response from students, teachers and other device components.
3. It is necessary to develop an automatic school bell that is connected to an Ethernet web server in the form of a web-based application
4. Can be developed by using more loudspeakers.
5. Needs to improve the sound, or in the design to make it one with the amplifier so that it doesn't take up a lot of space.
6. So that the finishing results of the automatic bell equipment are more attractive, the appearance of the box must be redesigned or the model updated

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