```
STM32ADC inADC(ADC1);


#define B1 PD0
#define B2 PD1
#define S1 PD5
#define S3 PD4
#define S2 PD7
#define S4 PD6


const int setOverflow = 4000;
const int DT = 50;
int count,data,data2;
uint8_t analog_pins[] = {PA0, PA1, PA2};
int vsin,act,vact,arus,iact,err,err_v,iref;
double itg, lastitg, pi, mod, Bmod, P, I;
double vref, itg_v, lastitg_v, pi_v, P_v, I_v;
int car1,car2,car3,car4;


//control
float kp_v = 0.001;
float ki_v = 0.1;
```

```
void PINMODE() {
 pinMode(B1, OUTPUT);
 pinMode(B2, OUTPUT);
 pinMode(S1, OUTPUT);
 pinMode(S3, OUTPUT);
 pinMode(S2, OUTPUT);
 pinMode(S4, OUTPUT);
}

void serial()
{
  Serial.print(vref);
  Serial.print(" ");
  //Serial.print(car1);
  //Serial.print(" ");
  //Serial.print(car2);
  //Serial.print(" ");
  //Serial.print(car3);
  //Serial.print(" ");
  Serial.print(iact);
  Serial.print(" ");
```

```
 Serial.println(vact);
}
void setup() {
 Serial.begin(9600);

 PINMODE();
 for (uint8_t x = 0; x<sizeof(analog_pins); x++)
 pinMode(analog_pins[x], INPUT_ANALOG);

 Timer2.init();
 Timer2.pause();
 Timer2.setMasterMode(TIMER_MASTER_MODE_UPDATE);
 Timer2.setPeriod(20);
 Timer2.setMode(TIMER_CH2, TIMER_OUTPUT_COMPARE);
 Timer2.setCompare(TIMER_CH2, 1);
 Timer2.attachInterrupt(TIMER_CH2,INT1);
 Timer2.refresh();

 Timer3.init();
 Timer3.pause(); // stop timer
 Timer3.setMasterMode(TIMER_MASTER_MODE_UPDATE);
 Timer3.setPrescaleFactor(3); //5.2Khz
 Timer3.setOverflow(setOverflow);
```

```
 Timer3.setCount(0);
 Timer3.setMode(TIMER_CH1, TIMER_PWM);
 Timer3.refresh();
 Timer2.resume();
 Timer3.resume();
 inADC.setSamplingTime(ADC_SMPR_3);
 inADC.enableDMA();
}
void loop()
{
 if (Timer3.getCount() >= 2000)
 count = setOverflow-Timer3.getCount();
 else
 count = Timer3.getCount();
 car1 = map(count, 0, 2000, 0, 2000);
 car2 = map(count, 0, 2000, 2000, 4000);
 car3 = map(count, 0, 2000, -2000, 0);
 car4 = map(count, 0, 2000, -2000, -4000);

 R();
 serial();
}
void INT1(void){
```

```
 vsin = map(analogRead(PA2), 0, 4095, -4000, 4000);
  vref = map(vsin, -4000, 4000, 4000, -4000);

  act = map(analogRead(PA0), 0, 4095, -4000, 4000);
  vact = map(act, -4000, 4000, 4000, -4000);

  arus = map(analogRead(PA1), 0, 4095, -4000, 4000);
  iact = map(arus, -4000, 4000, 4000, -4000);
 }
void R(){

err_v = vref - vact;
  P_v = kp_v * err_v;
  itg_v = lastitg_v + err_v * 0.00001;
  I_v = ki_v * itg_v;
  pi_v = P_v + I_v;

  if (pi_v > -4000 && pi_v < 4000) // current anti windup
  {
    lastitg_v = itg_v;
  }

//Bidirect 1
```

```
 if (pi >= car1){
  digitalWrite(B1, 1);
 }
 else {
  digitalWrite(B1, 0);
 }
//Saklar 1
 if (pi >= car2){
  digitalWrite(S1, 1);
 }
 else{
  digitalWrite(S1, 0);
 }
//Bidirect 2
 if (pi >= car3){
  digitalWrite(B2, 0);
 }
 else{
  digitalWrite(B2, 1);
 }
//Saklar 2
 if (pi >= car4){
  digitalWrite(S2, 0);
```

```
}
else{
 digitalWrite(S2, 1);
}

////ZC////
if (pi >= DT)     //zero crossing
{
digitalWrite(S3, 0);
digitalWrite(S4, 1);
}
else
digitalWrite(S4, 0);

if (pi <= DT)     //zero crossing
{
digitalWrite(S3, 1);
digitalWrite(S4, 0);
}
else
digitalWrite(S3, 0);}
```

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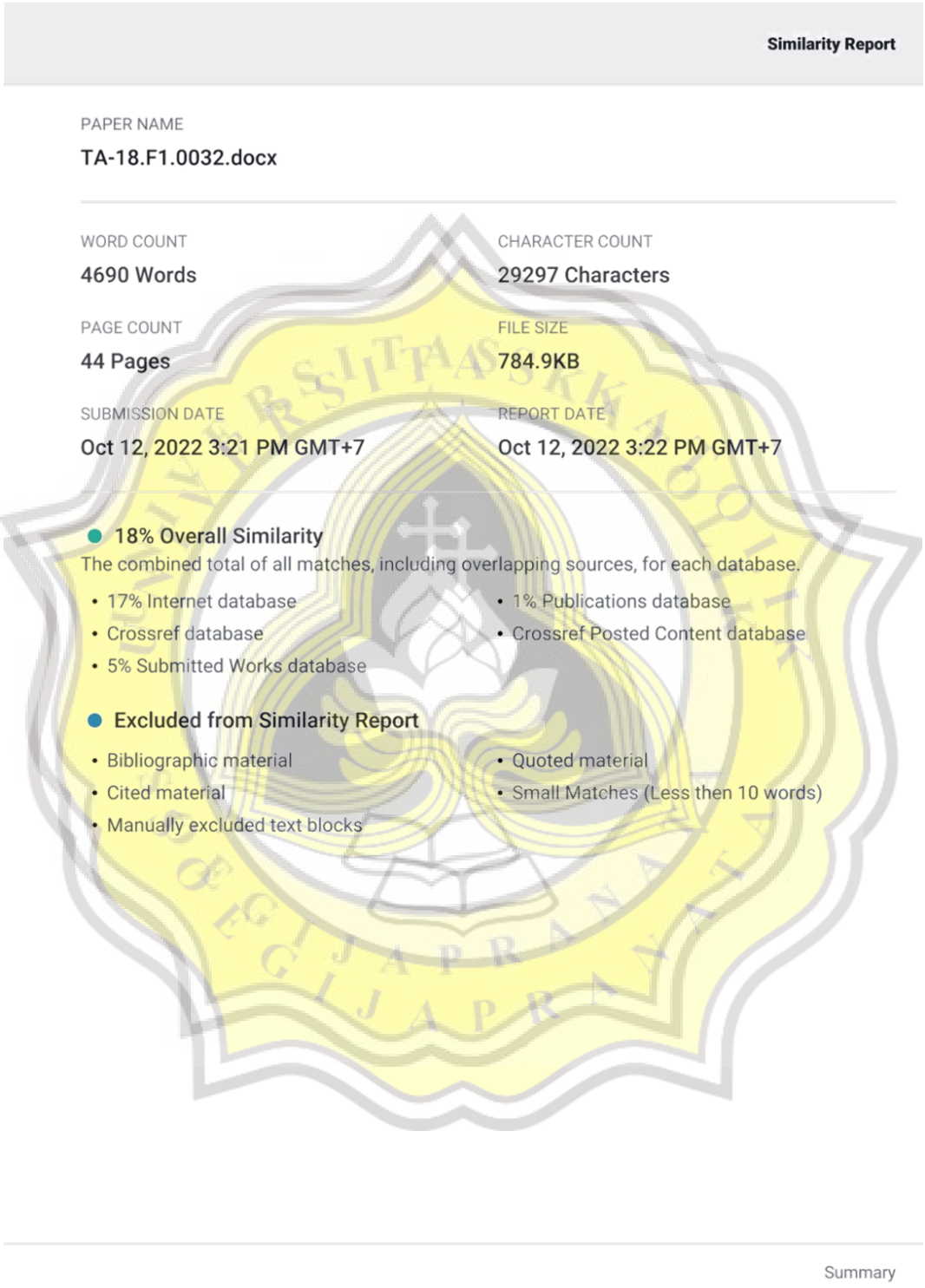

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